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Forthcoming Events.

NOVEMBER 24.

Institute of British Foundrymen (London Branch):—Ordinary meeting in London. "The Foundry Cupola and Mechanical Charging," Paper by A. A. Liardet.

Swansea Technical College Metallurgical Society:—General meeting at Swansea. "The Variables in Technical Education," Paper by L. Taverner, A.R.S.M., D.I.C.

Institute of British Foundrymen (Sheffield and District Branch):—Joint meeting of the Derby and Sheffield branches. "The Effect of the Composition of Cast Iron on its Properties," Paper by Prof. Bulleid.

Institution of British Foundrymen (West Riding of Yorkshire Branch):—Ordinary meeting at Leeds. "Structural Weaknesses in Castings and their Elimination," Paper by O. Smalley.

Institution of British Foundrymen (Newcastle-on-Tyne and District Branch):—Ordinary meeting at Newcastle-on-Tyne. "Blast Pressure and Volume for Cupola Working," Paper by F. J. Cook.

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Fatigue in Cast Iron.

Because of some recent litigation, foundrymen throughout the country are discussing the possibility of fatigue in connection with cast iron. The casting dealt with in this law case was a four-blade cast-iron propeller. Generally speaking, the stress associated with such a propeller is one characterised as prolonged, external and relatively low. Now, fatigue is technically understood to relate to alternating or repetition stresses, and except in a general sense should not have been used in such a case. Some foundrymen have been searching for literature dealing with the subject of fatigue in cast iron, but little is available, as such high factors of safety are generally used that they exclude cast iron from any discussion of the failure of metals under low and prolonged stresses, let alone alternating or repeated stresses. Any question of slip bands, space lattice, inter-crystalline amorphous cement, or analogous bases for theories can be ruled out owing to the presence of relatively large quantities of graphite.

Perhaps those interested would gain some information upon which to theorise from a study of "The Failure of Metals under Internal and Prolonged Stress"—a book which contains the discussions on numerous papers presented to a joint meeting of several scientific societies with the Faraday Society. Throughout the whole of the discussions cast iron is scarcely mentioned. Wrought and malleable iron, too, are neglected. Yet these three metals are of first-rate importance to the engineer, and in the aggregate are equal to any of the alloys or metals discussed.

The subjects of internal failure under prolonged stress, cracks, and corrosion are intimately associated. Cast iron, having relatively large quantities of graphite present, is possibly ideal for the purpose of resisting such stress, especially when annealed and the normal casting strains relieved, because the graphite prevents the continuity of the stress. However, for corrosion, the graphite provides passages for the entrance of rusting agencies. Wrought iron, from one point of view, can be considered as the inverse of steel. In the latter case, when cooling from the liquid, pure iron first solidifies followed later by higher carbon material, whilst in the former, the material surrounding the first deposited nuclei is increasingly pure iron. This probably accounts for its superior resistance to corrosion, whilst the presence of slag may act as the graphite in cast iron and relieve internal stress.

As to black-heart malleable iron, one can deduce, studying the subject from the same aspect, that the presence of amorphous carbon would take up and help to dissipate any low prolonged stresses. From the point of corrosion malleable iron should rank between cast iron and wrought iron, unless drastic over-annealing has left hair-cracks relatively larger than the graphite in cast iron, then it would assume a worse place than cast iron as a rust resister.

Thus for all practical purposes foundry metallurgists can eliminate from their discussions the question of "fatigue" in cast iron, but should certainly examine the behaviour of that material under low and prolonged stress.

D

Linseed Core Oil.

By J. H. Cormack, B.Sc.

Following upon a few notes in the issue of August 16 of the Foundry Trade Journal suggesting the use of a colloidal form of linseed oil, and the benefits which might be anticipated from its use, the subjoined details of the results obtained in actual trials will be of value to those interested in the improvement of coremaking materials.

This is a branch of work in which, on a broad view, comparatively little progress has been made, and the general lack of standardised materials capable of ensuring uniform results is a serious matter to the foundry trade. In the examination of sands, in the mechanical and physical methods of sand preparation, and in the provision of the most suitable artificial bonding materials, there lie great possibilities of improvement and economy. Hence, in this matter particularly, the ear of the keen worker must be kept close to the ground that he may, like the scout, be forewarned of such movements as are taking place in a region closely affecting him.

Up to the present the one core-bond that deserves description as a standard has been linseed oil—painters' oil. Such an expensive oil as this, which is specially prepared to meet the various requirements of a totally distinct trade, cannot possibly be all that the foundryman would desire, while doubtless the particular features most highly appreciated for painting purposes are not only useless in the foundry but also relatively costly.

In view of these facts the preparation of what may be distinguished as a linseed core oil suggested that something might be achieved if an improvement could be effected in those qualities of the original oil which are of value in coremaking, and if it proved possible to eliminate or modify others of a less desirable nature so that the net result might be a linseed oil product better adapted to foundry requirements.

It will be understood, therefore, that the following remarks and figures apply to a comparison between the standard grade of boiled linseed oil and a modified linseed oil in which an effort has been made to adjust the properties as stated. The nature of these modifications can best be indicated by dealing with the several aspects from which such a problem has to be attacked, and the resultant product may be referred to as *colloidal linseed core oil*, or, briefly, *CLCO*.

Strength of Colloidal Linseed Core Oils.

The first essential quality in a core being its ability to withstand and support the various stresses and strains to which its function causes it to be subjected, the discussion of other properties must be pivoted upon the proportion of artificial bonding material required in order to give it the requisite strength. When this is measured by testing to destruction a core 6 in. × 1 in. × 1 in. loaded centrally and supported on 4 in. centres, the results obtained are:—

With Sea Sand

(*a*)	Linseed oil	(3½ per cent.)	1,000 to 1,400 oz.
(*b*)	CLCO	(3½ ,,	1,400 to 1,600 oz.
(*c*)	CLCO	(3 ,,	1,200 to 1,400 oz.

With Fine Silica Sand.

(*d*)	Linseed oil	(4 per cent.)	1,100 to 1,500 oz.
(*e*)	CLCO	(4 ,,	1,800 to 2,000 oz.

From these figures it will be seen that a satisfactory comparison can be made between the value of ordinary linseed oil and of colloidal linseed core oil, and it is on this that the subsequent figures are based.

The feature of linseed oil which embodies its principal defects from the foundry point of view is its ready conversion into a gas-rich, hard, impermeable film. Colloidal linseed core oil being a scientific preparation for core purposes is prepared so as to avoid such impermeability to gas and so to eliminate the tendency of the "core-blow" common to cores bonded with ordinary painters' linseed oil, whilst the same strength and robustness of core may be obtained from 10 per cent. less quantity of the colloidal preparation on account of its active mixing properties.

Green Sand Properties.

In the qualities associated with the green state CLCO appears to be a slight improvement on its predecessor, but the difference is not sufficiently marked to be recorded so far as tests on plasticity have as yet been carried. A difficulty arises here in the absence of any recognised tests which measure these "green" properties satisfactorily—strength, plasticity, endurance, etc. The dropping test, for example, introduces (1) a vertical shear force proportional to the overhung length, and (2) a bending effect proportional to the square of this length which gives horizontal tension and compression in the upper and lower portions respectively, with secondary shear forces in a horizontal direction. That is to say, there is a complicated stress system which in an elastic material such as steel can be resolved into its several elements, but which, in a plastic material, admits of no clear deduction being drawn. Some simpler and more direct tests are therefore desirable.

Drying Desiderata.

The "drying" of linseed oil is a process of oxidation in which atmospheric oxygen combines chemically with the oil and forms the film or skin which is typical of paintwork, as may be observed on an exposed surface of the oil. In the core oven the process therefore consists not in the comparatively simple one of driving off so much moisture, but in providing suitable conditions for oxidation and necessitates an adequate flow of air through the oven. In ordinary practice 1 lb. of linseed oil requires 1 lb. of oxygen or 4.5 lbs. of air, so that 100 lbs. of green linseed oil cores will require a minimum of 13.5 lbs. of air. The whole of this requires to be heated to 380 deg. F., thus absorbing a corresponding quantity of heat, and resulting in a large amount of heat loss and reduced stove capacity.

Due to the smaller proportion of air necessary for an oil prepared as CLCO, fuel, draught and time are saved to an extent of 52 per cent., while the capacity of the core oven is correspondingly increased and the quality of the work done in it improved. The "creeping" effect which is clearly due to the higher proportion of linseed oil made necessary in consequence of its painting qualities, disappears with the diminished quantity of oil and with the more thorough mixing which can be effected.

Precisely the same considerations—less oil, thorough mixing and improved stoving—result in high venting power. A material such as linseed oil is designed, when used in paint, to give a continuous and elastic film, and to resist the formation of pores during the process of drying, and in this respect is obviously capable of improvement for foundry use. By the elimination of such impervious films, the venting power or permeability is found to be increased by 75 per cent.

On the whole it is clear from the foregoing remarks that there is ample scope for the improvement of ordinary linseed oil and that it lends itself to such modification as renders it more serviceable in the foundry, and can be prepared as a standard product for foundry purposes as distinct from the other uses for which its ordinary grades have been developed and adapted.

In closing, the author has to thank the Directors of the Chemical and Technical Engineering Company, Limited, particularly Mr. Granton, for allowing him to publish these data from their research laboratories.

Automobile Statistics.—At the beginning of 1923 there were about 14,500,000 registered motor vehicles in the world, and the United States and Canada owned 88 per cent. of them. The proportion of the annual world output is probably even higher, for the United States and Canada together dominate the markets of most importing countries. The argument that the industry is dependent upon road improvement is refuted by the fact that France, with a population of 39,000,000 and famed for its good roads, has only 200,000 passenger cars and 95,000 trucks; Great Britain, with 47,000,000 population, has 353,000 passenger cars and 145,000 trucks; while Canada, with a population of only 9,000,000, has 462,000 passenger cars and 38,000 trucks.

A Consideration of Some Mechanical Tests on Cast Iron.*

By Prof. F. Siegle, of Nancy Technical College.

A great many attempts have been made to correlate the figures resulting from tensile, transverse, shear and Brinell hardness tests of cast iron. This is not by any means easy, and it is probable that any direct interdependence that may exist will only be applicable within narrow limits of conditions and composition. Last year at the Nancy Congress the author described how he had carried out a series of tensile, transverse, Brinell hardness and impact tests, together with an investigation into the modulus of elasticity on a number of hematite irons (phosphorus below 0.12 per cent.). Fig. 1 shows the relative values of the first three properties.

Recently, the author carried out experiments, particularly on shear and transverse, on some

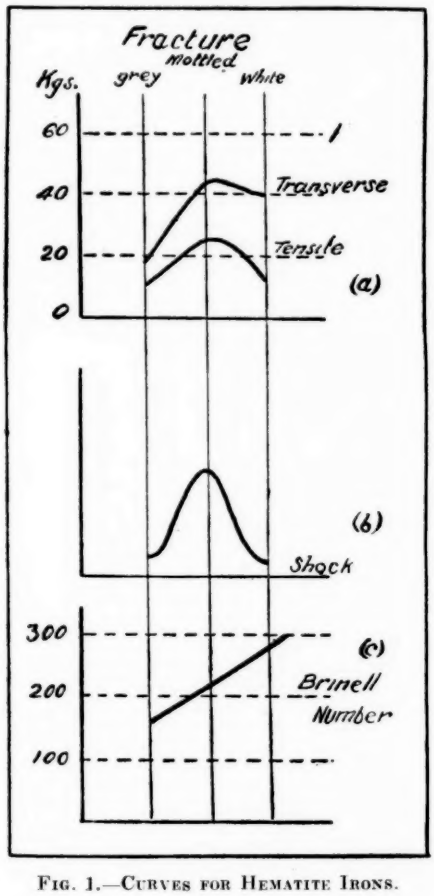
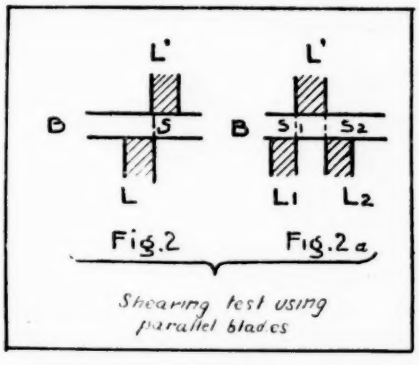


FIG. 1.—CURVES FOR HEMATITE IRONS.

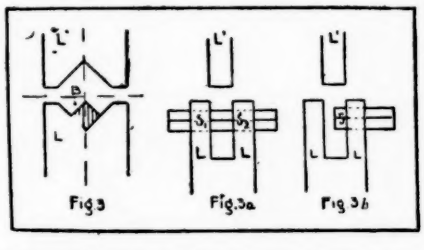
hematite irons, and also on some of the phosphoric iron of the eastern provinces of France; these contained phosphorus to the extent of 1.80 to 2 per cent. The most interesting results of these experiments were briefly as follows:—

Shear Tests on Cast Iron.

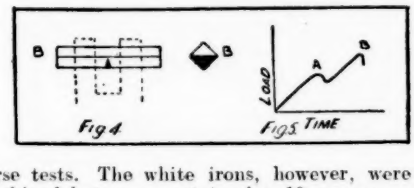
In making experiments on shear tests the stress may be applied to one or two sections, i.e., single or double shear. The shear blades, too, may be of various forms, parallel, as shown in Fig. 2, or square, as Fig. 3. M. Fremont, in his work on test methods, employed parallel blades and the test piece in single shear as shown at S, B, Fig. 2. M. Martens gives a number of results with parallel blades L_1, L_2 and L^1, and the bar in double shear, S_1 and S_2, on the right of Fig. 2. But he calls attention to the fact that, with cast iron in double shear, there are bending moments to be accounted for. The author of the present paper adopted the arrangement due to Aimsler, who used shear blades which formed a square as shown by L, L' in Fig. 3. If the test bar is placed as in the centre sketch (Fig. 3) it is in double shear, and if held as in the right-hand sketch (Fig. 3) it is in single shear. Making the test in double shear, the gradual increase in load at last leads to a sudden, noisy rupture of the bar, generally about midway between the supports (See Fig. 4). With a grey iron this fracture is generally only partial



involving the lower half of the section which has been submitted to a tensile stress. After this the load may be increased and shearing of the two sections, S_1 and S_2, takes place, sometimes together, sometimes separately; the failure of the metal is indicated by the sound and by the retreat of the indicator on the machine. The sequence of events is shown by the graph Fig. 5; A is the point of initial rupture due to bending, whilst the true shearing load is shown at B.



After making a number of experiments on both single and double shear, it was decided that, where cast iron was in question, the single-shear test gave the best comparative results, besides enabling a larger number of tests to be obtained from one sample. Grey irons failed quietly in shear, whereas the whiter variety broke suddenly and noisily. Shear tests were made on bars 10-mm. square (0.394 in.), machined to size from larger bars or cut from bars cast for tensile or trans-



verse tests. The white irons, however, were not machined but were cast to size, 10-mm. sq.

It is safe to say that at the present time tensile tests on cast iron are not in favour, in spite of the fact that tensile figures are quoted in most reference books. This suspicion is especially strong when the test bars are cast separately, and may consequently have a structure entirely different from that of the casting they are supposed to represent. But even when test pieces are

* Translated from a Paper presented to the Paris International Congress.

machined from the castings themselves there is always the chance that the least error in form may result in bending stresses which will cause the premature failure of the bar. Moreover, even slight defects, such as blowholes, coldshuts, sand or slag inclusions will reduce the test results out of all proportion to the extent of the defects. It is a difficult matter to cast white iron into sound bars of small section and long enough to serve as tensile test pieces; thus a bar cast in the ordinary course may give results more or less inferior to those of a sound bar made of the same metal. A simple experiment showed the effect of small defects in test bars. A square test bar was cast and a small hole was drilled through it at right angles to the length. Several of these bars failed, as would be expected, at the reduced section across the hole, showing an ultimate tensile stress of 10.7 to 11.4 tons per sq. in. Two bars, however, broke at a point away from the hole and across the full section of the bar; the breaking stress in these cases was only from 5.7 to 6.4 tons per sq. in. The cause of this great fall in strength was a very small flow in one corner across which fracture had occurred.

Transverse Tests.

Transverse tests were then carried out on bars laid across two supports and loaded at the middle. These bars were sometimes simply cast in round or square section, sometimes square or rectangular bars of various dimensions machined to size. Other tests were made on the Monge apparatus with bars, as cast, 40 mm. × 40 mm. (1.57 in. × 1.57 in.). These experiments showed that a number of factors considerably influenced the results, such as whether the bar was of light, say ½-in. sq., or heavy, say 1.5-in. sq., section; the distance between supports; the form of the bar, whether round or rectangular; and whether the test piece

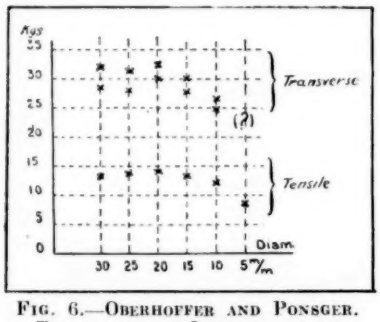


FIG. 6.—OBERHOFFER AND PONSGER. TESTS ON THE INFLUENCE OF THE DIMENSIONS ON TEST-BAR RESULTS CUT FROM THE SAME BLOCK OF IRON.

is as cast or machined. From purely theoretical reasons it can be understood that there would be variations in the stress per unit area in transverse tests of bars of different sizes, but practical experience alone can determine the importance of the differences arising when the conditions of test are altered. In the case of cast irons, for example, the different results must be considered according to the particular grade under test, from the very grey to the white. In the very grey irons the large flakes of graphite constitute zones of weakness, the effect of which would become very exaggerated on bars of small section. The effect would lead to a totally wrong idea of the transverse or tensile qualities of this iron. Such results must not be confounded with those relative to the variations shown by bars of different sizes when cast from the same molten metal, for in this case the rate of cooling influences the result even more than would a change of composition; the rate of cooling alters the structure and all the mechanical properties. To appreciate the real effect due to change of section it is necessary to cut all the test pieces of varying dimensions from the same piece of material. Unfortunately the machining of the mottled white irons becomes impossible: the test must be made on the bars as cast, the section being of the order 10 mm. × 10 mm. (0.394 in. × 0.394 in.) if shear tests also are necessary. When grey irons are being tested the lack of homogeneity due to the flakes of graphite must be considered. The white irons are very brittle and more liable to form blowholes than the others, whilst the casting of small bars presents difficulties. In these cases, and with the ordinary grades in common use, there are certain to be discrepancies between individual tests of transverse, tensile or shear, even from the same sample of metal. In the graph Fig. 8, the thick vertical lines represent the extremes of the same type of test. Fig. 9 shows how diverse are the results obtained by repeating a test a great many times; the figures have all been reduced to a common factor to render them comparable. If it is possible to make only one test of each kind on a series of samples, there will necessarily be many discrepancies between the comparative results, as the graphs show. To the author's knowledge, Messrs. Oberhoffer and Pönsger are the only workers who have carried out experiments to show the effect of different dimensions on test pieces of very grey iron, all cut from a single block cast in a single shape in order to ensure homogeneity; the results were published

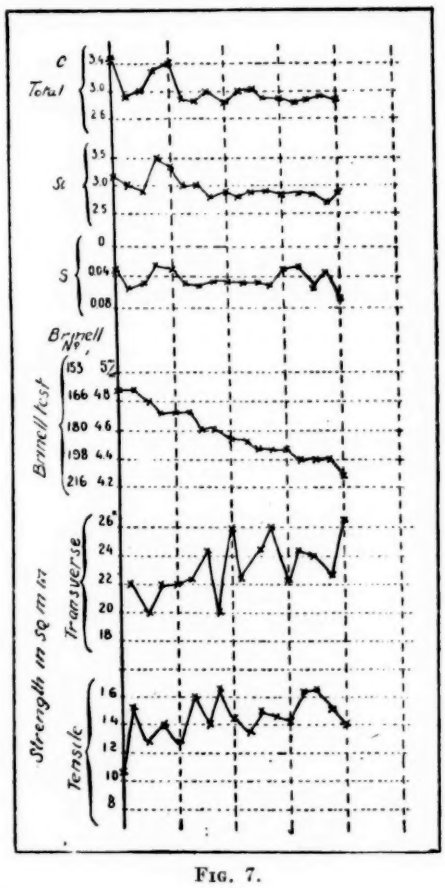


FIG. 7.

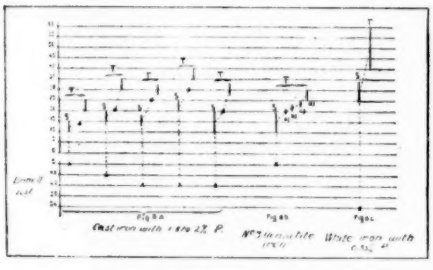
in "Stahl und Eisen" for August 3, 1922. These experimenters cast a block of iron almost 2 ft. sq. and 2 ft. 7 in. long, weighing nearly 2.5 tons. From the lower portion of this block they cut a slice rather less than 2.5 in. thick, from which they made a series of round bars of different diameters which were then tested in tension and transverse. The bars for transverse tests were of the following proportions:—

Diameter in mm. ...	30	25	20	15	10	5
Area in mm.²	707	491	314	177	78	20
Distance between supports mm.	600	500	400	300	200	100

Relationship of Tensile to Transverse.

Tensile bars were also made, the diameters being the same as above. The composition of the iron was: Total carbon, 3.24; silicon, 1.78; manganese, 0.55; phosphorus, 0.38; and sulphur, 0.08 per cent. The graphite content was round about 3 per cent. which showed a very grey fracture on account of the very slow-cooling of such a large mass. Results of these tests are given on the

graph Fig. 6. As indicated, the resistance of the very small bars to tension and transverse is much lower than for the largest sizes. Those of average size show slightly better results than the latter. Evidently the transverse test on the smallest bar gave such discordant results as to exclude it from the graph. It is probable that the lack of consistency in the smaller bars is due to the want of homogeneity, caused by the graphite flakes mentioned before. Although the experimenters did not calculate the ratio transverse stress, it is interesting to note that with bars of the same diameter under bending and tensile tests this ratio nearly always approaches very closely to the figure 2.15: this value also corresponds to that found by the author when experimenting on certain hematite irons. This is a striking illustration of the truth of the statement that it is useless to



compare transverse and tensile tests without taking into account the size of the bars under test; even if they are taken from the same block of homogeneous material.

High Phosphorus Irons.

The diagram Fig. 7 gives the following data relating to irons having a phosphorus content of 1.8 to 2 per cent.: Total carbon, silicon content, sulphur content (increasing from the top to the bottom of the diagram), diameter of Brinell impression (ball 10-mm. dia., load 3,000 kg.), ultimate tensile strength (round bars cast 22-mm. dia., turned to 18 mm.), transverse test (on bars 40 × 40 mm., made by Monge's method). Since only one test of each kind was made, which accounts for the irregularities shown in the graphs. The irons were graded according to the decreasing diameter of the Brinell impression, which led to the first, fourth and fifth of the series being classed as No. 3: their sulphur content, too, is very low.

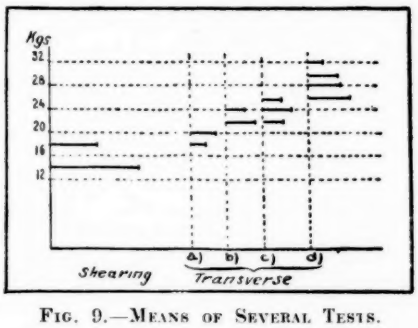


FIG. 9.—MEANS OF SEVERAL TESTS.

The last five were graded No. 5, all the others being judged as No. 4. On the whole, the Brinell diameter decreases in proportion as the metal becomes less graphitic, which, in turn, corresponds to smaller contents of carbon or silicon, or perhaps both, which agrees fairly well with industrial results. The series tested corresponds to the more siliceous cast irons of low carbon. The resistance to tension and transverse of the greyest irons comes out rather lower on the average. There is no apparent relation between the mechanical properties and the sulphur content.

Dimensions, Transverse and Shear Test.

Next a series of tests was made to determine the influence of the dimensions of the test pieces for transverse testing and to compare the transverse results with shear results.

(1) *Irons containing 1.8 to 2 per cent. P.* Fig. 8a represents, graphically, the results obtained on five irons containing 1.8 to 2 per cent. phosphorus, and all classified according to the decreasing diameter of the Brinell impression. The values of the shear tests are marked "S" on the diagram, and those relating to transverse strength are marked "T," the latter figures being obtained from two series of bars. For each material the ordinate on the left refers to bars of 750 to 1,000 sq. mm. (1.16 to 1.55 sq. in.), the section being 30 mm. (1.18 in.) to 40 mm. (1.57 in.) wide by 25 mm. (0.985 in.) thick, the distance between supports being 100 to 150 mm. (3.94 in. to 5.9 in.). The ordinates—marked T—on the right refer to bars 100 sq. mm. (0.155 sq. in.), the section being 10 mm. × 10 mm. (0.394 sq. in.), with a distance of 50 mm. (1.97 in.) between supports. One test for each quality of iron was made on the larger bars, but on the smaller bars repeat tests were taken. The individual results, when repeat tests were possible, differed more or less. The thick vertical lines on the graph indicate the maximum and minimum values obtained. Only

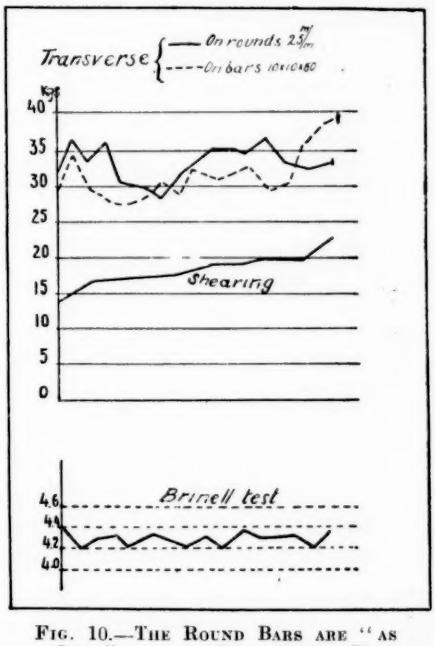


FIG. 10.—THE ROUND BARS ARE "AS CAST," AND THE RECTANGULAR BARS MACHINED.

the results obtained from sound bars were recorded.

(2) *Hematite Iron, No. 3.*—The graph Fig. 8b shows the results obtained from this material, the following conditions being observed:—

(*a*) Rough bars, as cast, 40 mm. × 40 mm. (1.57 in. × 1.57 in.), 300 mm. (11.8 in.) between supports.

(*b*) Rough bars, as cast, 40 mm. × 40 mm. (1.57 in. × 1.57 in.), 130 mm. (5.1 in.) between supports.

(*c*) Bars 10 mm. × 10 mm. (0.394 in. × 0.394 in.) cut from test bars above, 100 mm. and 180 mm. (3.94 in. and 7.1 in.) between supports.

(*d*) Bars 10 mm. × 10 mm. (0.394 in. × 0.394 in.) cut from test bars above, 50 mm. (1.97 in.) between supports.

Fig 9 shows the variations of 43 shear tests on bars 10 mm. × 10 mm. (0.394 in. × 0.394 in.) taken on one section, and the result of 48 deflection tests under the four conditions enumerated.

Third Series of Experiments.

Fig. 10 refers to comparative tests on iron with 1.80 to 2 per cent. phosphorus, classification numbers 4 and 5. Shear tests (the mean of four tests for each cast) and transverse tests on round bars 25-mm. dia. (0.985 in.) as cast, the transverse tests were the average of two or three tests for each cast, and finally the average diameter of the Brinell impression. The materials were classed according to the average of the shear test results

in ascending order. Neither the resistance to deflection nor the Brinell impression showed, on the whole, any relation to the varying shear values. On a machined bar 10 mm. × 10 mm. (0.394 in. × 0.394 in.) the last cast of the series gave a resistance to shear equal to that for deflection, whilst the three deflection tests on the cast bar 25-mm. (0.985-in.) dia. only gave a load approaching the mean of the other bars.

White Iron Tests.

Experiments were conducted on white iron with 0.40 per cent. phosphorus content. Fig. 8c gives the comparative results of static deflections, very slowly applied to rough cast bars 10 mm. × 10 mm. (0.394 in. × 0.394 in.) and with 50 mm. (1.97 in.) between supports. This figure also gives the comparative results of shear tests on the same bars. The figures obtained were very high but very irregular, 24 to 34 kgs. per sq. mm. (15 to 21 tons per sq. in.) in shear and 30 to 60 kgs. (19 to 37 tons per sq. in.) on the transverse test. The Brinell diameter was very small. Tensile tests on such a material would only give the lowest results on account of the brittleness and blowholes, which would cause premature fracture.

Results Examined.

It is advisable to make a number of tests and to take the mean of the results. Repeated tests are of especial value in the case of shearing on the bars of small section for which the amount of metal used is small. It is, moreover, a matter of doubt whether shear tests taken on a cross section of 500 sq. mm. (0.775 sq. in.) or more give the same average per unit area as the smaller bar—so easy to test—of, say, 100 sq. mm. (0.155 sq. in.). The average figures so obtained are more applicable to industrial practice than would be the case with absolute values. M. Frémont has made the very ingenious suggestion that shear tests should be taken on small, round, test pieces cut from the castings themselves by means of a special tool. For example, a test piece 5.64-mm. dia. would give a section of 25 sq. mm. It might be expected that with such small test bars the results of separate tests would be very discordant; this would especially be true of the very grey irons. Moreover, on the white irons the boring tool would not be able to cut the material. According to M. Frémont, the resistance to shear should be equal to the ultimate tensile strength. Experiments by Martens have confirmed this. On the other hand, the author of the present paper has obtained ratios, $\frac{\text{shear}}{\text{tensile}} = 1.2$; in exceptional cases 1.4 on very grey iron. For the mottled white or white irons it is almost impossible to prove any relationship in this direction, because for these materials the shear strength is very great, whilst the tensile strength is very low owing to a number of accessory factors.

Relationship Between Shear and Transverse Strength.

This ratio varies greatly according to the conditions governing the bending test. With bars of large section the deflection load may be 1.2 to 1.4 times the shear load, and for bars of small section the transverse load equal to 1.7 to 2 times the shear load. But it is evident that isolated results of either shear or tensile tests may be widely divergent, owing to deviations occurring in individual tests, whilst the results might exhibit a relationship in the average.

(To be continued.)

Russian Mining Concession to French Group.—A French group of capitalists, together with the well-known Russian industrialist Zoivotovsky, have obtained large concessions in the Krivoi Rog coal and iron ore district for a period of 50 years. The concessions have been confirmed by the Government. It is intended to begin working in the spring.

Synthetic Wood.—A so-called synthetic wood has been produced by PROF. GEORGE KEMMERER at the chemical laboratories of Wisconsin University. It is made from sawdust ground to powder, mixed with a binder and moulded under heavy pressure. The product is said to be harder and tougher than natural wood and impervious to water. The composition takes on a good finish of varnish or enamel. It can be cut with a saw and holds screws firmly.

Company News.

Allen Everitt & Sons, Limited.—Interim dividend, 7½ per cent. per annum, free of tax, on ordinary.

Siemens Brothers, Limited.—Dividend, 10 per cent. on preference shares for twelve months to June last.

Electric Construction Company, Limited.—Interim dividend, 6 per cent. per annum on ordinary shares, less tax.

Gas Generators and Industrial Furnaces, Limited, Wicklow Street, London, W.C.1.—Capital £5,000 in £1 shares.

British Piston Ring Company, Limited.—Net profit, £3,660; brought forward, £4,102; dividend, 7½ per cent.; carry forward, £4,498.

John Brown & Company, Limited.—The directors have decided to pay an interim dividend on the ordinary shares at the rate of 5 per cent. per annum, less tax.

Allen & Elshaw, Limited, Cliffe Foundry, Calley-white Lane, Dronfield, Derby.—Capital £3,500 in £1 shares. Engineers, founders, etc. Directors: H. A. Elshaw, W. H. Butler, and W. Lockwood. Secretary: H. A. Elshaw.

James Mills & Company (Engineers), Limited, Moss Iron Works, Foundry Brow, Heywood, Lancs.—Capital £25,000 in £1 shares (4,000 7 per cent. cumulative preference and 21,000 ordinary). Directors: M. W. Mills and E. Ramsbottom.

Tankless Gasholder Company, Limited.—Capital £4,500 in £1 shares, to adopt an agreement with Maschinenfabrik, Augsburg Nurnberg A.G., of Nurnberg and Gustavsburg, Germany. Gas engineers, gas plant manufacturers, etc. So long as Samuel Cutler & Sons, Limited, C. & W. Walker, Limited, and Ashmore, Benson, Pease & Company, Limited, hold 1,500 shares they may each appoint one-third of the directors.

Personal.

MR. F. J. C. POLE, general manager of the Great Western Railway, has left London for the Sudan, where he will inspect the railways and steamers.

MR. G. D. DELPRAT, formerly general manager of the Broken Hill Proprietary Company, has been elected a director of Hadfields (Australia), Limited.

MR. GEORGE E. CLARK has joined the board of Workman, Clark & Company, Limited, Belfast. He is the eldest son of Sir George S. Clark, who was for so long associated with the company.

VISCOUNT LONG OF WRAXALL has accepted the presidency of the forthcoming Empire Mining and Metallurgical Congress to be held at the British Empire Exhibition on June 3 to 6 (inclusive), 1924.

MR. S. L. MURGATROYD, Mr. R. F. Bennett, and Mr. T. B. Willans have been appointed permanent-way engineer, chief construction assistant, and chief assistant construction department, respectively, for the London & North-Eastern Railway Company.

Wills.

BOUCHER, W. E., of Kidderminster, Worcs., and of Prunella, Limited £5,879

Legal Intelligence.

Thos. W. Ward *v.* Hallamshire Metal and Engineering Company.

In the King's Bench Division, on November 9, £500 damages were awarded to Thos. W. Ward. Limited, Albion Works, Sheffield, in an action brought by them for non-delivery of steel scrap by the Hallamshire Metal & Engineering Company, Limited, Denby Street, Sheffield, under a contract made in August, 1922.

Mr. Ward, assistant managing director of the plaintiff firm, gave evidence to show that the defendants had never suggested to him that they were excused the contract because of the French decree. Mr. Geo. Wood, a local director of the plaintiffs, said in evidence that the difference between the contract price and the market price in April, 1923, was 25s. a ton.

Mr. Thomas Wild, managing director for the defendants, said they had delivered to plaintiffs as much of the scrap as had been supplied to them by their sellers. Witness was not aware of the French decree until some considerable time after it was passed.

After hearing further evidence, Mr. Justice Bailhache said he thought the decree was a justification for non-delivery after January, 1923, but by that time he thought the defendants ought to have delivered 500 tons more than they did deliver. Taking an average of the prices at April given by both sides, the difference between the market price and contract price was £1. On that basis he thought the proper damages were £500.

Methods of Analysis of Coal.

The Department of Scientific and Industrial Research has issued an Interim Report on methods of analysis of coal, compiled by the Fuel Research Board, and recommended for adoption in connection with the physical and chemical survey of the national coal resources which is now in progress. This publication, "Physical and Chemical Survey of National Coal Resources, No. 2," states that a full report, embodying an account of the experiments made by the Committee, will be presented to the Fuel Research Board, with a view to publication at a later date. Meanwhile, to avoid unnecessary delay, the Committee decided to recommend the issue of the description of the methods as a separate pamphlet. In the interest of uniformity, the Committee express the hope that these methods will receive general recognition in this country and, with this object in view, they invite the co-operation of chemists interested in the analysis of coal. It is the intention to revise the publication periodically, to verify any new suggestions by experiment, and thus to present to analysts and coal-users generally an authoritative statement of the best current practice in the methods of valuing coal. It is pointed out that throughout the Report, except where otherwise stated, the expression "finely powdered coal" should be understood to mean coal which has been air-dried and ground to pass through a 60-mesh I.M.M. sieve.

Approximate Analysis.

Determination of Moisture.—Weigh 1 to 2 grammes of finely-powdered coal in a shallow weighing-vessel provided with a well-fitting cover. Heat the uncovered coal for 1 hour at a temperature of 105 to 110 deg. C., cool the covered dish in a desiccator charged with concentrated sulphuric acid, and weigh covered. Express the loss of weight as moisture. The weight of coal and the diameter of the dish should be arranged to give a layer of coal weighing not more than 0.3 gramme per sq. cm. of exposed surface. A convenient form of oven is that in which a constant temperature is maintained by boiling toluene or a mixture of glycerine and water. It is desirable to pass pre-heated air through the oven at a rate sufficient to renew the atmosphere 3 to 4 times per hour. Some coals show a special liability to oxidation; in such cases, a current of dry nitrogen or carbon dioxide should be used instead of pre-heated air.

Determination of Ash.—Heat from 1 to 2 grammes of finely-powdered coal, contained in a shallow platinum, porcelain or silica dish, approximately 1 cm. deep by 5 cm. in dia., at first slowly to prevent mechanical loss, and finally at a temperature of 750 to 800 deg. C., in an oxidising atmosphere, during one hour, or until constant in weight. Cool in a desiccator and weigh. A muffle furnace should be used, and provision should be made for the free circulation of air over the coal. A note adds that, for commercial purposes, the ash is usually accepted as a sufficiently accurate measure of the proportion of inorganic matter present.

Determination of Volatile Matter.—Weigh 1 gramme of finely-powdered coal in a platinum crucible, closed by a well-fitting internal capsule lid, place the covered crucible on a support of platinum or nichrome wire, and heat for 7 minutes at a temperature of 925 deg. ± 25 deg. C. Allow the crucible to cool, and weigh. The loss of weight represents the volatile matter, including the moisture, in the air-dried sample. Duplicate results obtained by the same operator should not differ by more than 0.5 per cent. In the case of a coal which decrepitates or suffers loss due to entrainment of solid particles, gentle heating with a small flame, for a sufficient period to prevent visible loss during the subsequent treatment, is desirable; or it may be necessary to use coarser coal. The crucible should have the following dimensions:—Diameter at base, 24 to 25 mm.; height, 35 to 40 mm.

A gas or electrically-heated muffle furnace, or an electrically-heated tube furnace, is recommended; the crucible should not rest on the floor of the muffle, but on a wire support placed thereon. To minimise the loss due to oxidation, which appears to be the chief source of error, a small tray charged with charcoal should be placed at the back of the muffle, and the front should be closed by a plate of uralite, asbestos, or other suitable material, to which is attached a wire cage filled with charcoal. To construct the cage, two discs of iron gauze are cut to fit loosely inside the mouth of the furnace, and these are joined to a strip of wire gauze about 25 mm. wide, leaving an opening at the top through which the cage is filled with charcoal.

If an open flame is used for heating the crucible, the gas pressure and the position of the crucible in the flame should be adjusted to give a temperature of 925 deg. ± 25 deg. C. on the bottom of the covered crucible inside. The temperature should be measured, before making the determination, by means of a thermo-couple passed through a central opening in a nickel cover and resting on the bottom of the crucible, or may be regulated so that the fusion point (940 deg. C.) of potassium chromate, placed on the bottom of the covered crucible, is just reached. If the necessary temperature cannot be obtained with an open flame, the crucible must be protected from excessive heat losses due to convection and radiation. Simple means of effecting this are to surround the crucible by an asbestos-lined cylindrical iron shield, which is attached to the tube of the burner and is provided with a regulator for the adjustment of the secondary air such as that designed by Davies, and which is illustrated in Fig. 1. As the percentage of moisture is deducted from the value found, the result obtained should be expressed as "volatile matter less moisture."

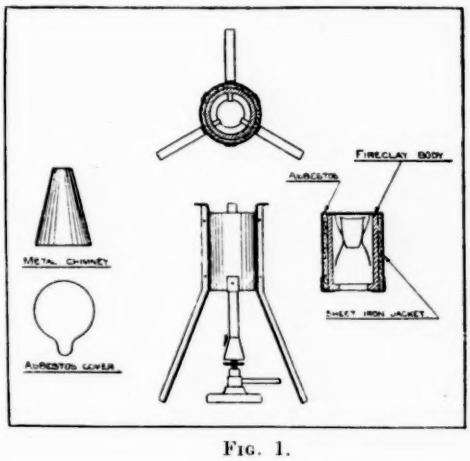


FIG. 1.

The value of fixed carbon is obtained by subtracting the sum of the percentages of moisture, ash and volatile matter from 100. As the designation "fixed carbon" sometimes leads to confusion, these words should appear in the report within inverted commas.

Ultimate Analysis.

Determination of Carbon and Hydrogen.—The following method is put forward provisionally. The apparatus used consists of a purifying train in duplicate for oxygen and air, a combustion tube supported in a suitable furnace capable of giving a temperature of at least 800 deg. C., and an absorption train for collecting the moisture and carbon dioxide formed during the combustion. The purifying train is made up of two wash bottles, one of which is charged with potassium hydroxide solution (2 parts, by weight, of potassium hydroxide and 1 part of water) and the other with concentrated sulphuric acid, followed by U tubes charged with soda lime and granular calcium chloride. Two such trains, connected to the combustion tube by a three-way tap or a similar device, permit of the use of dry oxygen or air as required.

XUM

The combustion tube should be of hard glass, of about 15 to 20 mm. internal dia., and at least 90 cm. in length. The charge of the tube, beginning at the end connected with the purifying train, is approximately as follows:—8-cm. space, 10-cm. oxidised copper gauze spiral through which passes a stout copper wire provided with a loop for convenience in withdrawal, 10-cm. space for boat, 45-cm. of granular copper oxide held in position by rolls of oxidised copper gauze 1 cm. long, 10-cm. of fused granular lead chromate followed by a roll of oxidised copper gauze 1 cm. long, 8-cm. silver spiral, 8-cm. space.

The three-way tap of the purifying train is connected to the combustion tube by indiarubber tubing attached to a glass tube passing through a well-fitting rubber stopper. The absorption train, which is connected directly to the other end of the combustion tube by a well-fitting rubber stopper, consists, in the order named, of (*a*) a U tube charged with granular calcium chloride, and (*b*) potash bulbs, containing an aqueous solution of potassium hydroxide (2 parts, by weight, of potassium hydroxide and 1 part of water), and fitted with a small side tube charged with granular calcium chloride.

Before use, the combustion tube is heated in a current of oxygen, maintaining the copper oxide at a temperature above 800 deg. C. and the lead chromate at a dull red heat; if the change in weight of the calcium-chloride tube and potash bulbs at the end of half an hour does not exceed 0.0005 gramme, the apparatus may be considered in proper condition. Alternatively, a blank combustion of an organic substance of known composition should be carried out. The quantity of the finely-powdered coal used is 0.2 to 0.3 gramme, spread evenly over the bottom of a porcelain or platinum boat about 8 cm. long. The combustion is started in a current of air, and the general procedure is the same as that ordinarily followed for the determination of carbon and hydrogen in organic compounds. The ash remaining in the boat should be carefully examined to ascertain whether any carbon has escaped combustion.

The granular calcium chloride should be saturated with carbon dioxide, and subsequently freed from the excess of carbon dioxide, before using, by passing a current of dry air through it. In place of granular calcium chloride, pumice saturated with concentrated sulphuric acid may be used for absorbing the water produced during combustion; in that case, the air and oxygen entering the combustion tube should also be dried by sulphuric acid. Instead of potash bulbs, U tubes charged with freshly-prepared soda lime may be used for absorbing the carbon dioxide. A determination of the amount of carbonate present in the coal is necessary, and carbon occurring in this form should be deducted from the total carbon in order to arrive at the carbon in the coal substance.

For the determination of carbonates the method of Dittmar or Lunge and Rittener, or some modification such as that described by F. S. Sinnatt and W. Harrison ("The Determination of the Carbon Dioxide in Coal." The Lancashire and Cheshire Coal Research Association, Bulletin No. 7, 1920), may be used. The authors' description of the last method is reproduced in an appendix to the Report.

The presence of water of constitution in the inorganic constituents, etc., which is not driven off at 105 to 110 deg. C., affects the accuracy of the determination of the hydrogen in the coal substance, but no reliable method exists for its determination. An approximate correction may be applied if the quantitative composition of the ash is known. It should be pointed out that if a coal is to be used for boiler tests, it is not desirable to make corrections either for the carbon of carbonates or for the hydrogen from water of constitution in the inorganic constituents.

Determination of Sulphur.—Eschka Method: Weigh 1 gramme of the finely-powdered coal in a porcelain, silica or platinum crucible and mix intimately with 3 grammes of Eschka mixture.* Cover the contents of the crucible with a further 1 gramme of the mixture. Heat gently at first to ensure the slow expulsion of the volatile matter, then gradually raise the temperature to a red heat and continue heating until the black particles have completely disappeared. During the final heating, the mass should be stirred with a stout platinum or nickel wire to promote oxidation. Transfer the charge to a beaker, wash the crucible thoroughly with hot water, digest with bromine water, add hydrochloric acid in sufficient excess to dissolve the solid matter, boil to expel the bromine and filter. Add 10 c.c. of a 10 per cent. solution of barium chloride and proceed according to the recognised method of determining sulphuric acid. The crucible may be heated by the flame of a spirit lamp or in a gas-fired muffle furnace in which the products of combustion of the gas do not come into contact with the crucible. If a coal-gas flame is used, the crucible should be inserted through a hole in a sheet of asbestos supported in a slanting position, so that the products of combustion of the gas are carried away and prevented from coming into contact with the mixture. In order to supply a correction for sulphur present in the reagents or absorbed during the determination, a blank experiment is conducted under the same conditions, and the weight of barium sulphate found in the blank is deducted from that obtained in the determination proper.

For coals containing more than 2 per cent. of sulphur, the amount taken for the determination should be reduced to 0.5 gramme. As some doubt has been cast on the reliability of the Eschka method for the determination of sulphur in coals containing more than 2 per cent. of sulphur, the figure obtained, in such cases, should be checked by carrying out a combustion in the calorimetric bomb.

Sulphur in Ash.—A determination of the amount of sulphur present in the ash, as previously determined, is necessary. This figure should be deducted from the total sulphur, and the difference should be reported as combustible sulphur.

Determination of Sulphur in Ash.

Digest the ash with hydrochloric acid evaporate to dryness, take up with hydrochloric acid and hot water, filter, and precipitate the sulphur in the filtrate with barium chloride. Proceed according to the recognised method of determining sulphuric acid.

Determination of Nitrogen.—Kjeldahl Method: Weigh 1 gramme of the coal, ground to pass through a 100-mesh I.M.M. sieve, and transfer it to a hard glass Kjeldahl flask; add 30 c.c. of pure concentrated sulphuric acid, 10 grammes of anhydrous sodium sulphate, and 0.6 to 0.8 gramme of metallic mercury.† Heat the mixture gently until the initial frothing has ceased, then boil the liquid until the solution becomes colourless (2 to 6 hours), and subsequently for a further period of 2 hours. Allow the contents of the flask to cool sufficiently to prevent violent reaction, then add a few crystals of potassium permanganate, finely ground, to complete the oxidation.

Dilute the cold solution to about 200 c.c. with water, fit the flask with a tap or thistle funnel and an efficient splash head, and connect, through a condenser if desired, to a bulbed tube dipping in 20 c.c. of N/10 sulphuric acid. Add through the funnel 100 c.c. of a solution containing 400 grammes of sodium hydroxide and 40 grammes of sodium sulphide per litre, and distil over 150 to 200 c.c. Titrate the excess of sulphuric acid with N/10 sodium hydroxide or potassium hydroxide solution using methyl orange or methyl red as an indicator. A blank determination, substituting pure cane sugar for the coal sample, gives the data necessary to supply a correction for nitrogen compounds in the reagents used.

It should be pointed out that the Kjeldahl method often yields results lower than those given by the Dumas method, owing to the evolution of some nitrogen as such during the process. If the Dumas method is used for the determination of nitrogen, a subsequent analysis of the gas in the nitrometer should be carried out to ascertain whether gases other than nitrogen are present, and any necessary correction made.

*This mixture is composed of 2 parts (by weight) of pure light calcined magnesium oxide and 1 part (by weight) of pure anhydrous sodium carbonate; pure calcium oxide may be substituted for magnesium oxide if the latter is not available in a sufficiently pure form. Traces of sulphate in the reagent are estimated by carrying out a blank determination.

†Copper sulphate may be substituted for mercury, in which case the addition later of sodium sulphide is unnecessary.

Determination of Oxygen.—There is no satisfactory direct method for the determination of oxygen in coal. In an ultimate analysis, this value is commonly estimated by subtracting the sum of the percentages of the other constituents from 100. The result so deduced is, therefore, burdened with all the errors incurred in the other determinations, and of these the difference between the percentage of ash and that of the mineral content originally present in the coal, already referred to, is usually the most serious.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Neglected Foundry Educational Facilities.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—May I support the suggestion made by Mr. J. H. List in his letter published in the Journal of November 8, under the above heading, that a definite national examination on foundry practice will supply that incentive necessary. At the present time, although many classes are being held in foundry practice, there is no attempt being made to work up to a definite standard, and, should examinations be set at the close of the session, as is usually the case, the success of a student has no specia lsignificance outside the immediate locality in which the examination is held. The certificate granted does not define the standard of attainment it represents. This is true of many certificates of course, but, when the examination is of a national character, then it does represent a definite standard of attainment and receives recognition to that extent in any part of the country.

The recently organised examinations in mechanical and electrical engineering are increasing in popularity, and the certificates obtained, as a result of these examinations, have the support of the Institutes of both Mechanical and Electrical Engineers, who determine the standard of attainment desirable and check the papers that are set. There does not seem to be any reason why the Institute of British Foundrymen should not use its organisation to support a national examination in foundry practice, and, with the active support of its members, there is no reason why the percentage of qualified foundrymen should not compare favourably with that of qualified mechanical or electrical engineers.

Under a scheme of national examinations a course in foundry practice should cover at least four sessions, each session's work terminating in an examination covering a definite syllabus. An additional incentive could be made by admitting the holder of a fourth year or final certificate to the Institute as a certified foundryman.

The question of class fees is not really of vital importance, they are bound to vary somewhat according to local conditions and circumstances. Some educational authorities, although the initial class fees are comparatively high, offer facilities for free tuition in subsequent years, providing students attend regularly and reach a reasonable standard of attainment during the preceding session. Thus a student taking a course for a national certificate in mechanical engineering may attend classes for four years at the cost of the fee for the first year. This is another incentive to those students who are prepared to work, and is worthy of consideration by educational authorities that do not offer such facilities to the progressive student.

Yours, etc.,
CHAS. A. OTTO.

Woolwich Polytechnic School.

MESSRS. BRITISH PIG IRONS, LIMITED, have appointed Mr. J. C. Bradford, B.Sc., as commercial representative. Though this company was only formed in the early part of this year, they now have no less than twenty-five representatives and agents throughout the world.

Institute of British Foundrymen.

NEWCASTLE BRANCH.—Junior Section.

At a meeting held on Saturday, November 10, Mr. E. J. Rang, B.Sc., read a paper entitled, "Some Metals Used in Engineering."

In his paper, the lecturer touched upon the construction of weapons in the early days, and said that, as copper was one of the few metals which occurred in a native state in fairly plentiful quantities, it was not surprising that all early work was done with that metal. It is stated that, by some process or other, the ancients were able to harden copper as steel is hardened nowadays, but the secret has apparently been lost, and no one in this present age of science has yet been able to discover it.

There was no doubt, he said, that the advent of iron was the greatest forward step in the history of the industrial world, and armed with such a discovery, progress, although not rapid, was sure.

The author then described the manufacture of steel, and said that the process by which some of the finest Sheffield steel was made did not differ materially from the early attempts at its manufacture.

In comparing the properties of cast iron with those of steel, he pointed out that steel possessed all the good properties of cast iron except one, together with many others which the latter did not possess.

The engineer used brass or bronze when he wanted a metal which did not readily corrode. Both of these alloys are fairly immune from corrosion and, up to the present, have held first place in the list of metals used for valves, etc., but now there is a rival on the market in the form of stainless steel.

As the corrosive effect of superheated steam is very great, fittings which come in contact with it are made of phosphor bronze, pure copper or cast steel. Here, again, is an opening for stainless steel, none of the aforesaid metals being entirely satisfactory. Stainless steel is yet in its infancy, and has not been applied to the many purposes for which it is eminently suited, but before long it will undoubtedly come into its own and displace many inferior alloys.

An excellent discussion, in which many members took part, followed the reading of the paper.

The membership of the Junior Section has now increased to sixty.

Contracts Open.

Kingskerswell, Devon, November 27.—1,100 yards of 3-in. cast-iron water main, with sluice valves and hydrants, for the Newton Abbot Rural District Council. Mr. R. A. Rogers, Union Street, Newton Abbot, surveyor.

London, E.C., December 3.—Steel tyres for carriages and wagons, for the Assam-Bengal Railway Company, Limited, Bishopsgate House, 80, Bishopsgate, E.C.2. (Fee, £1 1s., non-returnable.)

Macclesfield, November 28.—1,180 tons of cast-iron pipes and specials, for the Corporation. Mr. F. R. Oldfield, town clerk, 41, Churchside, Macclesfield. (Fee, £2, returnable.)

Ripley, Derby, December 8.—450 yards of 6-in. spigot and socket cast-iron water pipes with specials, etc., for the Ripley Urban District Council. Mr. G. W. Bird, surveyor, Town Hall, Ripley.

Graaf-Reinet, S.A., December 20.—(a) Cast-iron water pipes, valves and fittings; (b) crude oil engines, generators, etc., for the Municipality of Graaf-Reinet. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

London, E., November 26.—Two centrifugal pumps, together with pipes, fittings, etc., for the Isle of Dogs pumping station, London, E., each pump to be capable of delivering 16,800 gallons of storm water per minute, for the London County Council. The Chief Engineer, Old County Hall, Spring Gardens, Charing Cross, S.W.1. (Fee, £5, returnable.)

Newcastle-upon-Tyne, November 30.—One 20-ton hydraulic crane with accumulator and electrically-driven force pump, for the Tyne Improvement Commissioners. Mr. R. Aughton, general manager, Bewick Street, Newcastle-upon-Tyne. (Fee, £1, returnable.)

W. & H. COOPER, LIMITED, have been granted a licence under the Non-Ferrous Metal Industry Act, 1918.

Test Bars.*

By Robert Buchanan (Past President, Institute of British Foundrymen).

In considering the function of test bars only those relating to grey cast iron will be dealt with. In doing so it may be profitable to consider how far test bars convey an idea of the strength of the castings to which the test bars belong. It used to be doubted in many cases whether test bars were cast from the same iron as the castings, or the test bars specially treated to give better results than they would give otherwise. However much this practice may have obtained in the past, I think that with the advance of scientific ironfounding, and a better understanding of the function of the various constituents of cast iron, so far as my knowledge goes these practices have almost, if not wholly, ceased. Engineers had a very suspicious frame of mind as regards the honesty of test bars. The time has now come when they may dismiss these doubtful thoughts. The advance in foundry knowledge permits the foundryman, who knows his business, to produce test bars of any reasonable strength by straight, honest methods.

Over twenty years ago the author wrote an article for the "Engineering Magazine" entitled "The False Witness of the Test Bar." In this article it was shown and proved that even when cast from the same metal as the casting, and when cast separately from the casting, the test bar was not a true indication of the strength of the casting. This was especially the case when the casting was much heavier in section than the test bar. This conclusion was arrived at from tests made on separately cast-test bars compared with bars cast solidly on to the casting and then machined off. Some of the results obtained from the solidly cast-on bars were so low and alarming that they were not published. The author had no cure by which these differences could be obviated or it would have been given. The differences between normal test bars and heavy sections will persist unless the test bars are cast solidly on to the casting and machined off. By doing so there will be some alarming results for the foundryman.

It is pleasing to note that the Institute of British Foundrymen has a Committee on Specifications for Grey Iron Castings, under the chairmanship of Mr. John Shaw, in which an attempt is made to reconcile these differences by having test bars of larger section where castings of weight are concerned.

The main difference in strength between test bar and casting, unless they are of fairly equal section, is the development of a larger granular structure in the slower cooling casting. The inspecting engineer requires good, strong test bars, and the machine-shop foreman wants a casting which will machine freely. That means that in the test bar the particles of iron will be difficult to part, and in the casting the particles will be easy to part. The separately cast bar provides these two conditions of close structure in the test bar and open structure in the casting. Of course, references is made to castings of a section much heavier than the test bar.

Importance of Grain Size in Test Bar and Castings.

There is no doubt that grain-size has more importance than purity of the mixture of iron from a chemical point of view when strength of casting or test bar is a consideration. The rotary casting of pipes and other castings is a proof of this. In the case of pipes made by this process thicknesses have been reduced as compared with sand-cast pipes and yet the centrifugally cast pipes are stronger. This reduction of thickness and increase of strength is simply due to the smaller grain-size which results from the more rapid cooling.

More than 20 years ago the author carried out a number of experiments with test bars separately cast but of varying thickness. The tests were made on transverse test bars 2 in. by 1 in. to be tested at 36-in. centre. Four plates, 2 in. by $\frac{3}{8}$ in. by 42 in. long were cast and then machined to $\frac{1}{4}$ in. thick. From the same ladle the usual test bar 2 in. by 1 in. by 42 in. long was cast. The four $\frac{1}{4}$-in. plates were chained together and broken in the testing machine. They proved to be 40 per cent. stronger than the solid bar cast separately.

A bar 2 in. by 1 in. was cast solidly on to a heavy casting and then was machined off. That bar broke transversely at approximately 20 cwts.

Tensile Test Bars.

Two tensile test bars run from the heaviest part of the casting, one near the casting and the other as far away as was available. The test bar near the casting broke at 5 tons per sq. in. The other broke at 14 tons. When analysed the principal difference between the two bars was the combined carbon. This was lowest in the weak bar as might be expected. The slowly-cooled bar next the casting was the weak bar. In other words, its grain-size was larger than the other. With large grains, rupture readily takes place along the junction of the grains or crystals. In casting a ship's propeller should the test bar be put on the boss or the blade?

I.B.F. Tentative Specification for Grey Iron Castings.

This is a well-timed publication with which everybody should be acquainted. The names of the members of Committee, of whom Mr. F. H. Hurren is one, are sufficient guarantee that the subject has been treated in a competent way by a very able and experienced body of foundrymen and metallurgists. It is not proposed to review in detail the whole specification. The agreement to have a round bar 1.2 in. diameter by 21 in. long, recognised as an International Arbitration Bar, is of importance. It is better than having test bars of all kinds. In one case a transverse test bar 1-in. square-tested at 36-in. centres, is being used. Such a bar is instructive to those using it, but forms no comparison with other tests. In another case a tensile test was made on a bar $\frac{1}{4}$ in. dia. and was taken as representing a heavy casting of 2 tons weight.

The suggestion that the test bars should have diameters approximating somewhat to the thickness of the castings they represent is an important step in the right direction. That a round bar will give a truer representation of the casting than a bar with corners is doubtful. It is certain that a round bar will have fewer internal strains than one which is rectangular. Oughterbridge proved many years ago that the barrelling of rectangular test bars for a few hours eliminated these strains and sent up the transverse tests by a couple of cwts. on bars 2 in. by 1 in. The author proved that for himself by following Oughterbridge's advice. One has to admit that *all* test bars are only approximations to the real character and strength of the casting. Whether one applies physical tests—analytic tests—or microscopic tests, applied to test bars and castings, one can get nothing absolute, but only approximate.

The full details of the proposed specification have been published. Foundrymen will agree that it is a worthy attempt to put the casting and testing of test bars on a surer foundation. Probably there will be some considerable anxiety amongst foundrymen how they are to produce the thicker type of test bar when cast on the casting. However, with the advance in scientific iron founding, these difficulties will be successfully overcome.

Grey Iron Castings for Automobiles.

The author had the honour of being Chairman of the Sub-Committee of the British Engineering Standards Association dealing with that subject, and has pleasure in introducing for discussion the proposed specification for dealing with that subject. The British Engineering Standards Association, and the author, personally, will be glad to receive criticism and advice. In

* A Paper presented to the Coventry Branch of the I. B. F.; Mr. C. Dicken presiding.

dealing with the relation of test bar and casting, one can get a nearer approximate of test bar to motor casting than is readily obtainable when castings are so much thicker in section than the bars representing them. It is particularly desired to have views as to whether the transverse test bars should be ½ in. or 1 in. sq. The author favours the ½-in. sq. bar at 12-in. centres as it is a nearer approximation to the thickness of a cylinder than is a 1-in. sq. bar.

Proposed Specification.

Air-cooled and Jacketted Cylinders for Automobiles and Motor Cycles.

The iron to be of British manufacture. No heat treatment to be given after the castings are removed from the mould.

Tensile Test Bars.—With every 10 cylinders which are cast there shall be three test bars cast ⅞ in. dia. These are to be turned down to 0.564 in. dia.—equal ¼ sq. in. in section. To break at not less than 12 tons per sq. in.

Transverse Test Bars.—Also with each 10 cylinders three transverse test bars ½ in. sq. shall be cast and tested on knife edges 12 in. apart, and shall sustain a load of 400 lbs. applied at the centre, and shall show before fracture a deflection of not less than 0.12 in.

Iron Castings for Piston and Valve Guides for Automobiles and Motor Cycles (B. E. S. A. Specification).

Heat Treatment.—Pistons may be subjected to heat treatment at a temperature not exceeding 500 deg. C. after they are removed from the mould.

Tensile Test.—A test piece cast ⅞ in. dia. and turned to 0.564 in. dia., equal ¼ sq. in., shall show an ultimate tensile strength of not less than 12 tons per sq. in.

Transverse Test.—This is similar to that given for cylinders, that is, ½ in. sq. bar, to break at not less than 400 lbs., and give a deflection of not less than 0.12 in.

Provision of Test Bars.—With every 100 pistons, and every 1,000 valve guides, three tensile test bars and three transverse test bars, ½ in. square, shall be cast from the same ladle either in green- or dry-sand according as the castings are cast in green- or dry-sand. The test bars shall be cast as an integral part of the castings when practicable.

Fly Wheels.

Tensile Tests.—With every 100 flywheels which are cast three tensile test bars ⅞ in. dia. are to be provided. These are to be turned down to 0.564 in. The tensile strength not to be less than 13 tons per sq. in.

Transverse Test.—Transverse test bars shall be 1-in. sq. tested on knife edges 12 in. apart, and shall sustain a load of not less than 24 cwt. applied at the centre, and also show before fracture a deflection of not less than 0.075 in. The test bars to be cast in green- or dry-sand if the castings are cast in green- or dry-sand, and to be integral parts of the castings when practicable.

Analytic Limit.

The only chemical limits, and they apply to all the castings under consideration, are sulphur and phosphorus.

The iron shall contain not more than 0.12 per cent. sulphur and 1.20 per cent. phosphorus.

Testing Machines.

The author is of opinion that insufficient attention is given to testing machines to ascertain if they give a correct result when in use. They go too long without being calibrated, sometimes for many years. Some time ago a case came under the author's notice where rejection took place of very important heavy castings owing to the failure of the test bars. On a duplicate set of bars being sent to a University they proved amply strong, and the castings were accepted. This proved that the engineer's testing machine was wrong. Only for this proof a very serious loss would have accrued to the ironfounder.

The British Engineering Standards Association and the author personally will be glad of constructive criticism. He would specially direct attention to the proposed size of the tensile test bars as cast, and the diameter to which they are to be turned down. Also to the size of the respective transverse test bars as related to the castings they represent.

DISCUSSION.

Case of Small Foundries.

MR. G. E. ROBERTS said he wished to point out, at the risk of being charged with riding an old horse, that these test-bar analyses always seemed to press more heavily on the smaller firms who had no organisation or facilities for making such tests. Yet these tests appeared to become more and more essential to the larger buyers with a corresponding effect adverse to the small foundries. Now there were many firms who could deal with piston castings and other castings of a similar character—he would not go so far as to say cylinder castings, which he looked upon as a much more intricate job—who by reason of the smallness of their output in the aggregate could hardly acquire facilities which would ensure that their castings should be up to the requirements of the specifications. At the same time there was a tendency nowadays towards the elimination of the smaller foundry in the direction of producing repetition work. Further, while many small foundries were able to secure the output by reason of the tests which were demanded by firms to-day, they seemed rather to be ruled out of the bigger jobs, and were thereby pressed into jobbing work. This was obviously a somewhat grave position for some of the smaller shops, though it would certainly tend to assist other shops where mass production was the order. He thought that the commercial aspect of these chemical and physical tests as they affected the small foundries deserved consideration. However, his experience had proved the necessity for the smaller shops to expend, as far as they possibly could, an adequate sum in order to obtain information as to what they were actually producing, rather than to continue the making of castings, the constituent elements of which they had no exact knowledge.

Tests thought Reasonable.

MR. G. H. JUDD endorsed the point made by Mr. Roberts, saying that it was particularly noticeable when firms were sending out orders to the foundry that they also gave their specifications. And as Mr. Buchanan pointed out, the majority sent in analytical specifications, and he must confess that he had heard very little about mechanical tests. He agreed that the position should be reversed, and that mechanical tests should have the preference. As generally in Coventry the castings were machined to produce a very small thickness, it was necessary that a fairly strong iron should be utilised. He thought that Mr. Buchanan had been largely instrumental in introducing this ½-in. sq. section bar and testing at 12-in. centres in connection with automobile work, and so far as his experience of this class of casting went, he was confident it was on right lines. For many types of castings he certainly thought that an ½-in. square-section bar was much more comparable than one of 1-in. The test laid down by the British Engineering Standards Association of a 400-lb. load to the bar appeared to be reasonable, and should be attained with an ordinarily good iron. Could Mr. Buchanan give any figures of his experience of test bars cast from the same ladle in hot iron and cold iron?

MR. F. H. N. LANE, B.Sc., A.I.C., remarked that Mr Buchanan and his Committee seemed to have done their work very well, and as Mr. Judd had said, the tests put forward were nothing but what should be obtainable by good work and using good iron. The Committee had cut down the number of tests to a reasonable figure, and although suggestions had been made that they should have a multiplicity of test bars to suit different size castings, he thought that here they had struck the happy medium. Indeed, he did not see that any serious criticism could be offered on the subject.

MR. TWIGGER considered that the Committee of the Institute had brought out a very fair specification for test bars. No doubt they had been inclined to cut the number down almost to the minimum, but in his opinion one more at least might have been allowed. Mr. Buchanan had pointed out very explicitly that test bars could never be more than approximate to the strength of the casting concerned, and it did seem to

him that in using a 1.2-in. bar for a casting which was mainly 2-in. in section they would get a very much better result than they would by machining a test bar out of a casting. The remarks of Mr. Buchanan on the effect of the grain-size would be appreciated by everybody, but there was another point which occurred to him in connection with this matter. This was that in certain cases it might be desirable in order to obtain a very close grain in their metal to use either denseners or chills, and in that case, if they were to cast the proposed test bar in sand, they certainly would not obtain one which represented the structure of their metal, because their densener metal would be much stronger than the test bar. He regarded the Committee's specification as an honest attempt to place the question of test bars on a much sounder foundation. An interesting point was the effect of temperature. It was possible, he thought, that in casting a test bar, unless they were very careful as to the position of the casting, they might actually cast their test bar with a much cooler metal than they would be using for the bulk of the casting. Referring to chemical specifications, he would like to know whether it was proposed to make any alteration to these specifications in the case of castings which were subjected to a good deal of frictional wear, because he believed that combined carbon was the chief element affected when anti-frictional qualities were concerned. He wondered whether there was any desire on the part of the Committee to insist on this in certain exceptional cases. (MR. BUCHANAN: No; there is no clause dealing with that.)

Running the Test Bar.

MR. MORGAN asked was there any mention in the specifications about the size of the runner of the test bar, and was there any direction as to test bars being cast horizontally or vertically. If vertically, should any definite head of metal be used, because if cast vertically in dry sand with, say, 12 in. of head of metal, the density and soundness of the bar could be more easily effected than in horizontal sand moulds.

Chemical Test Conditions.

MR. F. HILL inquired how did the Committee suggest that customers should be persuaded to adopt their ideas on the subject when specifications were sent along for a chemical test rather than a mechanical one. How were they going to enforce a mechanical test if their customers would not accept it. Further, why did the lecturer think that a test bar made in loam was a rather difficult matter to deal with. He himself should have thought it was quite a simple operation.

THE PRESIDENT (Mr. C. Dicken, M.I.M.) said the ½ in. bar rather appealed to him in regard to the automobile trade, and he supposed Mr. Buchanan agreed that it should be cast in dry sand moulds. (Mr. Buchanan: "If it is a dry sand casting."). Did Mr. Buchanan think that a ½ in. test bar with 0.12 sulphur, 1.2 phosphorus, and, say, 2 per cent. silicon would come out hard on the machine? (Mr. Buchanan: "No.")

The Author's Reply.

MR BUCHANAN, in reply to the discussion, remarked that as to the squeezing of little foundries to the wall which Mr. Roberts had mentioned, it was a singular thing that it was the people engaged in the large foundries who attended those meetings and gatherings of a similar character. The small man who had not the required technical knowledge and skill was the one who ought to attend these meetings more than anyone else. Moreover, his experience of these gatherings was that the personal contact of members was of the greatest possible value, for if a man had a difficulty his brother foundrymen were always willing and anxious to help him, and this quite apart from the lecturer who happened to be giving a paper. If a man was not up to date then it was only a question of time before the economic law forced him out of the business. As to analytical specifications being preferred by engineers, to physical tests, as mentioned by Mr. Judd, he must confess that he was rather surprised at this, because they presumed the engineer knew something about physical tests, while in many cases they did not know all that an analysis conveyed. When they were reading an analysis they had to conjure up a mental picture of what all these combinations of elements meant in the final product, and therefore he repeated that it was a presumption on the part of people to put down an analysis and yet could not indicate to them exactly what was meant by it. As regards the temperature of castings, there was no doubt but that a hot-cast test bar was stronger than one which was cast dull. He was sometimes rather puzzled why this should be so, and he was largely guessing when he stated that it was probably due in a great measure to the condition of the carbon. In casting cast iron at a certain temperature the carbon readily came out of solution, and most of them would have noticed the kish, which was carbon. It always threw off when the metal was dull; he had never seen it do so when the metal was hot; and this fact showed that the metal was ready to give up its carbon when the temperature became lower. It was this dullness which appeared to affect the structure of the iron. Hot metal certainly gave them the best results in the structure of their test bars or their castings, and also afforded the cleanest test. Mr. Twigger had been inclined to criticise the diameter size of test bars mainly 2 in. thick, but this point brought them back to the difficulty which he had mentioned, and with which he understood Mr. Twigger agreed. Test bars after all were only relatively correct, and not absolutely so. They were all seeking for the absolute in various directions, but he thought they were never likely to get it. His view was that the main value of test bars lay in the fact that it induced them to put better metal into their castings than they otherwise would do.

Use of Denseners.

As to the use of denseners, they were only of limited application, and they had still to face the old difficulty of the slow cooling, heavy casting and the quicker cooling test bar. Mr. Twigger had also referred to his query in respect to the casting of the test bar on the casting itself. While truly representative of the casting, whether the result would be conducive to the happiness of the foundryman was another matter. There was no stipulation as to whether test bars could be cast horizontally or vertically. He himself always cast test bars of 42 in. on the flat, with sometimes curious results. Of two bars cast at the same moment from the same ladle one broke at 36 cwt., and the other did not break on a machine which was only good for 40-cwt. In casting a ½-in. bar he saw no objection to casting it horizontally. It certainly was very much simpler than trying to cast it on end. In regard to moulding test bars in loam he thought it was considerably more trouble to do so than in dry sand, and the cooling effect, which was really sought for, would not be any quicker or slower, and certainly not so mucky in sand as in loam. As to Mr. Hill's other query about customers giving them chemical specifications, he was hoping that the specifications issued by the B.E.S.A. would help to convert some of these people, although he was afrald that many of them would be somewhat persistent. He might say that he stuck out for a ½-in. bar in automobile work simply because he believed it gave a truer representation of the castings in use than would a heavier section. He would now like to ask them if they were casting a ship's propeller would they put the test bar on the boss or on the blade? That brought to a crux the difference between the effect of the cooling period on the bar. Neither physically nor analytically would they find the test bar on the boss agreeing with the test bar on the blade, which brought them up against the fact that they obtained only approximate results and not absolute ones as between the test bar and the casting. In regard to the exceptional cases mentioned by Mr. Twigger, the specifications left the matter very largely in the hands of the foundry, and the foundryman could work his tests out anyway he liked so long as he kept within those two limits for sulphur and phosphorus.

Before closing the meeting Mr. Buchanan was accorded a vote of thanks.

Institute of British Foundrymen.

BIRMINGHAM BRANCH.

At a meeting held at the Birmingham Chamber of Commerce on November 8, Mr. J. B. Johnson presiding, MR. O. SMALLEY, of Monkseaton (Messrs. Armstrong, Whitworth & Company), read a Paper on the subject of "Alloy Cast Iron," which was given last session before the Sheffield Branch and has been published in the FOUNDRY TRADE JOURNAL.

Before throwing open the meeting for discussion, THE PRESIDENT called upon Mr. Stanley G. Flagg, Junr., a past-president of the American Foundrymen's Association, to address them, and said that if anything was wanted to cement the friendship of British foundrymen towards their American cousins it was the recent visit of the American delegation which had left enduring friendship between the two peoples.

American Malleable Practice.

MR. FLAGG expressed the pleasure which it gave him to be present, and said he had been greatly edified by the Paper. He remembered the Paper read by Mr. Smalley before the English-speaking session in Paris and the great respect and consideration with which it was received. He was much interested in Mr. Smalley's experiments regarding the direct production of malleable iron. It had been talked about for many years, and it seemed to him that with a gentleman of Mr. Smalley's knowledge and experience something tangible might result. It was hardly to be expected, however, that the experiments would produce immediate results. He was also much interested in Mr. Smalley's earlier remarks about total carbon. The main trouble they had in his country—and he supposed they experienced the same difficulty in England—was to get a uniform total carbon from a cupola furnace, and as the malleable process was based primarily upon carbon conditions it was a question with which all of them had been very much concerned. They used a good deal of steel in their malleable cast iron for the purpose of keeping down total carbon and of diluting some of the other elements that they naturally found. They did not, as a rule, in America try to extract carbon as they did in England, but even under those conditions it seemed to him that unequal carbon composition would call for unequal treatment in the annealing. In America they only changed the character of the carbon. What he had heard gave him food for a great deal of thought, and he wanted again to express his satisfaction at being present.

Vote of Thanks.

Proposing a vote of thanks to Mr. Smalley, MR. F. J. COOK said the lecturer had come to the fore in a short time so far as his published work was concerned, but he was, nevertheless, a gentleman who had created a good impression and had produced work the result of which was food for thought. His work commanded attention, and bore the stamp of being thoughtfully and well carried out. They all wished to tender to Mr. Smalley hearty thanks for his presence and very valuable Paper.

PROFESSOR THOMAS TURNER, in seconding the motion, said he had listened with interest to the Paper, and he was sure everyone had been struck with the variety of subjects introduced by the lecturer. One would have liked to have more information on a number of them, but many of the experiments had been of an exploratory character and opened up new branches of thought.

The motion was enthusiastically approved.

DISCUSSION.

Opening the discussion, PROFESSOR TURNER said the lecturer had introduced an interesting theory with reference to the solution and separation of graphite from cast iron and had led them to think of the graphite occurring in some kind of cloudy form resulting from its original shape and size, as it began to separate, and then he supposed to grow and so on. They heard a great deal at the present time about very finely divided materials and about those fine particles that passed almost into the liquid so as to become ultra-microscopic. He did not think they could get very much information as to what took place in the solution and separation of graphite from the ordinary constitutional diagram. The constitutional diagram assumed that they had equilibrium, and in all cases of castings they did not get equilibrium in ordinary foundry practice. If they took the iron immediately after it had solidified and chilled it, the quantity of graphite present was relatively small, and as they allowed it to cool further and chilled it at different temperatures the proportion of graphite increased. The graphite continued to grow as the cast iron cooled until it ceased to increase at a temperature of about 700 deg. Conversely, it had been shown that if they heated a piece of grey cast iron which contained graphite, say, in a flaky form, the graphite gradually dissolved. The lecturer had spoken about nodular graphite. What did he mean by that? He was not sure that nodular graphite, as he understood it, was a substance to be desired in a malleable casting. If they took a piece of malleable cast iron and overheated it in the annealing process they would form what he called nodular graphite. When they did that they got inferior quality due to overheating. He took it, however, that this was not what the lecturer was aiming at, so that they ought to have some kind of arrangement between them as to what they called nodular graphite. With reference to the effect of any element added to cast iron, there were, of course, two influences possible. There was first its effect upon the ferrite. He would lay it down as a general principle that there was no element known that would dissolve in iron so as to make a solid solution which would not, in suitable proportions, improve the quality of the metal. The question was as to what proportion should be added.

Copper in Cast Iron.

Then there was the other effect, very profound in some cases, on the solubility of the carbon and the nature of the graphite that was formed. Reference had been made to the effect of copper. A research was conducted a year or two ago by a student (Mr. Meredith) which, unfortunately, had only been published in abstract by the British Cast Iron Research Association. That research confirmed and extended the work which Mr. Smalley had mentioned. Apparently the lecturer's alloys were stirred before being poured, the result being that when they were examined under the microscope small globules of copper were observed. Obviously, metal of that sort would not be suitable for general use in the foundry. Up to a certain small proportion no doubt copper could be beneficial, but beyond that there was not only the question of expense to be considered but irregularity.

Review of Elements in Cast Iron.

MR. ARTHUR MARKS said that work which he had done for one of our large manufacturers of Diesel engines covered much of the work carried out by Mr. Smalley in connection with the addition of alloys to cast iron, and he thought he had covered every element dealt with by Mr. Smalley. Copper was an element that one jumped to right at the outset on account of its natural toughness, but the trouble was that when they got beyond 5 per cent. in any large casting or even in a small test piece there was a segregated appearance, and above that quantity it was impracticable, apart from the fact that expense cut it out entirely. Aluminium was a useful element in small percentages, but it formed a compound with iron and they made a highly brittle alloy instead of malleable material. Nickel was also a very useful element because it formed a series of solid solutions with iron. The advantages, however, were negatived by its cost. It was not a commercial proposition to make a fifteen-ton casting containing 5 to 10 per cent. of nickel. After a long series of researches he came to the conclusion that the most desirable results for such castings as Diesel engines could be accomplished by proper additions

of steel and manganese. Chromium was the only other cheap agent that it was possible to use, but in that case the high melting point and the exceedingly ready oxidisibility negatived one another. With regard to the direct casting of malleable iron it was a fascinating subject, and he got so far as to leave preliminary specifications on the matter in the Patent Office. In this case, again, one was limited for commercial reasons to elements which were found chiefly in steel. We were not by any means in sight of the solution of the problem of direct malleable, although it offered interesting possibilities. As to draws and porosity in castings, there could be no doubt there were other factors besides the metal in connection with draws forming at the junction of a casting. A riser at the joint insufficient to feed it but sufficient to get away the gas would result in a solid joint. The nickel alloy appeared to him to be the most successful as a strengthener apart from manganese, but, generally speaking, its cost placed it out of court.

Copper in Cast Iron Test Bars.

MR. D. WILKINSON said he was led to experiment with the addition of copper by his recollection of the practice of an old foundryman who, when he was making a test bar, used to add one of the old pennies. The old man stated that he could always get a much better test bar with the addition of the copper than without it. For a long time he thought it was a whim on the man's part, but he had since come to the conclusion that there was wisdom in the old man's action, even if there was not commercial integrity in it. He was inclined to think that the old man had been led by rule of thumb not exactly to a solution of his trouble but certainly to an improvement in his test bars. He pointed out that the specific gravity of graphite was about 2.25, and that of iron round about 7, and asked how they could be thoroughly mixed. He had devoted a considerable amount of thought to the problem, and he had never yet been able to think of a method, either colloidal or other, which would enable graphite to remain suspended perfectly throughout cast iron. He held the view that the graphite must be in a state of complete solution as graphite in order to retain its state of admixture. It had always seemed to him that the primary graphite separated out just at the point when the iron became "kishy" and that before that point it must be in a state of complete solution.

THE AUTHOR'S REPLY.

Replying upon the discussion, MR. SMALLEY defined nodular graphite as that form of graphite which existed in the iron and which did not give rise to mechanical weakness. Copper and nickel in combination were among the most promising additions. As to Diesel engine cylinders, he would not like to say that manganese and steel were the last word on the question. In his own practice he did depend upon manganese and steel, but at the same time there were very few Diesel engine people who were getting a satisfactory life or service from their cast irons, and in consequence they were either using steel or they were going out of this country to get castings. In using copper he preferred to use a copper-iron alloy containing 10 per cent. of iron. With regard to Mr. Wilkinson's reasoning on the suspension of graphite in the molten cast iron, he admitted that the factor of the density of graphite against that of cast iron was appealing. They must not overlook surface-tension effect, gaseous effect and other conditions which were far away from the actual difference between the density of the components of the graphite and the iron. He looked to those influences to explain why solid graphite could be retained in cast iron in a cloudy or finely-divided form, evenly. Similarly, according to Mr. Wilkinson's reasoning with graphite under those conditions they would have to do away completely with the thermal equilibrium diagram. As far as he knew, chromium, molybdenum and tin did definitely strengthen cast iron hot and rendered it less likely to fracture, but without knowledge of the other changes which occurred in the iron due to the presence of these elements, the result might be more disastrous than beneficial. As to the effect of sulphur on strength, personally he always believed in keeping sulphur low, not because he was afraid of it but because it was safer. If they gave a man a low sulphur iron they were more likely to get good, clean castings, although for some special purposes one got a better life from a high sulphur iron than from a low. Consequently it was almost a subject in itself.

The Utilisation of Foundry Coke Breeze.

(FROM A CORRESPONDENT.)

One of the most obvious economies in running costs is the utilisation for steam generation of the fine coke breeze. This, however, is under ordinary conditions an almost impossible fuel to burn because, whilst it possesses the characteristics of all low volatile fuels in being extremely difficult to ignite, it is in such a fine state of division that it mostly falls between the bars or, if forced draught be adopted to get over the ignition difficulty, is blown off the grate unburnt. The importance, however, of the problem is well illustrated by the example of the town of Sheffield which possesses dumps and filled-in quarries of hundreds of thousands of tons of foundry coke breeze. The problem of burning this material, which, of course, has a very high heating content, has however been solved by a special adaption of the "Turbine" steam-jet forced draught furnace.

It will be remembered that the ordinary "Turbine" furnace consists essentially in the use of a number of "elements" or small transverse fire-bars placed in large longitudinal trough steam jet bars forming a composite furnace bar, and between each small bar or element there is a straight air slit about $\frac{1}{8}$ in. wide. In the new development these transverse elements have instead 8 or 9 tiny air slots, so that the surface of a 6ft. grate in a standard "Lancashire" boiler contains about 2,000 holes, and the forced draught air supply is consequently so sub-divided that the light material is not blown off the bars before it can be burnt, whilst at the same time the special design of these slots is such that unburnt fuel cannot fall between the bars.

With regard to Sheffield, the foundry breeze mentioned has an average analysis of 65.5 per cent. fixed carbon, 6.75 volatile matter, and a heating value of 10,250 b.th.u. At the present moment one firm in Sheffield is obtaining with the "Turbine" furnace a result of 5.7 lbs. of water, at 80 deg. F. per lb. of coke breeze on "Lancashire" boilers, and evaporation over 6,000 lbs. of water per hour, which is approximately equal to 75 per cent. of the average performance with expensive coal. Also if this breeze is mixed in the proportion of two parts to one part of coal, the results are equal to ordinary coal on natural draught, the evaporation being about 7,500 lbs. of water per hour on a standard "Lancashire" boiler.

In the same way, of course, the fine breeze from soft gasworks coke can be utilised, and in the past century this material has been thrown away to the extent of millions of tons. The day is, however, passing for these happy-go-lucky methods, and the prevention of waste is to-day one of the most important problems of industry.

Production of Pig-Iron in October.

The production of pig-iron in October amounted to 592,600 tons compared with 558,600 tons in September, and 481,500 tons in October, 1922. There were 188 furnaces in blast at the end of the month, a decrease of two compared with the preceding month, and a total decline of 35 since the end of May. The total includes 171,200 of hematite, 198,600 tons basic, 164,900 tons foundry, and 23,300 tons forge pig-iron. The output of steel ingots and castings amounted to 702,100 tons compared with 695,100 tons in September and 565,200 tons in October, 1922.

Cleveland Institute of Engineers.

Another session of the Cleveland Institute of Engineers was inaugurated on Monday night, November 12, when the newly-appointed President, MR. H. B. TOY, delivered his presidential address to a meeting held in the Technical Institute, Middlesbrough.

Dr. J. E. Stead.

The meeting was appropriately opened by the retiring President, MR. C. H. ARCHER COULSON, making a sympathetic reference to the death of the late DR. J. E. STEAD—one of the oldest members of the Institute, an hon. member and a Past-President. Dr. Stead, he said, gave ungrudgingly of his great store of knowledge to further the interests of the Institute. To the younger members he always held out a helping hand and assisted them in every way, and he did it in a great-hearted manner characteristic of the man. The meeting passed in silence a vote of sympathy.

Annual Report.

The healthy state of the Institute was reflected in the annual report and balance-sheet, presented on behalf of the Council by the Secretary, Mr. W. H. Burns, who reported a membership of 419 at the opening of the 60th session, and an income of £745 10s., which, after meeting expenditure, left a surplus of £44 4s. 2d.

The report and balance-sheet were formally adopted.

Presidential Address.

The PRESIDENT, in the course of his address, remarked that the application of science to the iron and steel industries had received considerably greater attention during the last few years, and it had become a matter of necessity that the leaders of these industries should acquaint themselves with the latest results of the research work which was carried out, not only in this country, but also by our competitors abroad; otherwise there was great danger of the methods employed in our works becoming obsolete. He suggested that the most valuable means of education was to travel in other countries, and ascertain by observation the methods adopted by our competitors to overcome difficulties, which were presented almost daily, in branches of industry in which our manufacturers were concerned.

One of the most valuable possessions in the British Isles was our deposits of coal, and it was important that the owners should dispose of them to the best advantage of the nation, and that the users should employ every means of economy. It was unfortunate that coalowners found it necessary to export coal to countries where it was used in the manufacture of goods which were exported to this and other countries at a lower price than we could possibly produce them, due, he understood, to the difference in rates, taxes, railway rates, canal dues, wages, etc. The price of coal, in his opinion, dominated the trade of our country to a very great extent, and, considering the fact that twenty years ago we were buying best-quality furnace coal at 10s. per ton, for which we are now paying 31s. per ton, it was difficult to understand how we in this country, having to export a very large percentage of our manufactures to foreign countries, could possibly compete with other countries where they had cheap water-power and cheaper coal.

Continuing, the President reminded his hearers that the deposits of iron ore in the United Kingdom were decreasing very rapidly; it could therefore be reasonably assumed that the importation of foreign ores would gradually increase; the Tees Commissioners had already made improvements to the River Tees, and he thought they might rely upon them to anticipate the future requirements of works situated on or near to the river. The importance of the cost of handling raw materials should be judged by the fact that in normal times the quantity of iron ore imported into the British Isles amounted to about 6 million tons per annum.

Very great improvements had recently been made in the designs of blast furnaces, and by the introduction of cintering plants, mechanical chargers, increased blast pressure and temperature, important economies in the manufacture of pig iron had resulted. Mechanical charging of blast furnaces was quite recent in this country, whereas in America it had been a long-standing practice.

In regard to steel, the bulk of the production was made by this country in the acid open-hearth and the basic open-hearth. The Bessemer process, both acid and basic, particularly the latter, was steadily declining, and the Middlesbrough district did not now produce steel by those methods. Acid open-hearth steel production was confined almost entirely to the cold process of scrap and hematite iron, and was so universal in its practice that there was little to add to what was already well known, the greatest variation in practice being confined to the amount of scrap used per charge. In the basic open-hearth process, the practice was much more varied. Using scrap with cold pig-iron was the practice followed where blast furnaces were not in operation. Where there were blast furnaces, scrap was used to a more or less limited degree, and in many cases the active mixer practice was worked where pig-iron from the blast furnaces was semi-refined for its use in the steel furnaces. It was a matter of some contention whether the active mixer practice was more economical than the American practice of large receivers of 1,400 to 1,500 tons capacity, as opposed to the smaller active mixer of between 400 and 500 tons capacity.

It was in the production of basic open-hearth steel, continued the speaker, where the larger outputs were obtained, the scrap and cold pig-iron practice having actually reached outputs, with 75-ton capacity furnaces, upwards of 900 tons per week. The active mixer practice, with a limited amount of scrap, had an output approximating the same with a furnace of 600 tons capacity. These outputs were eclipsed by the tilting type of steel furnace, which, with its active mixer practice, approached 1,500 tons per week, and with an ordinary receiver approximated 1,300 tons.

Fuel Consumption.

The question of total output for the shop, and of fuel consumption, was of extreme importance, and it was doubtful whether the active mixer, feeding fixed or tilting furnaces, as opposed to the large receiver with its low running costs, was more economic, provided always that in both cases suitable iron could be obtained from the blast-furnace plant adjoining. The tilting-furnace process had many distinctive advantages over the fixed-furnace practice, the slags being more controllable, and, as they were of paramount importance in the making of basic open-hearth steel, it was a fact that should not be overlooked. The initial cost of the tilting furnace, as opposed to the fixed furnace, and the cost of upkeep, had done much to prevent its more universal adoption, but on the question of output it had established beyond doubt its superiority.

Its initial cost compared with the larger fixed furnace, with its 70 to 80 tons capacity, was not so important, as the capital expenditure of a melting shop was governed by the amount of molten steel required to be handled at one time, and here again the tilting furnace, with its 50-ton ladles, as opposed to the 60- and 70-ton ladles for a fixed furnace, had an economy in shop construction which was important.

With regard to the upkeep per ton, there was little difference between the tilting furnace and the large fixed furnace. Each of these furnaces was now capable (owing to their improvement in design and arrangement) of running continuously for six months at a time, after which the repairs necessary did not take much longer than 10 to 14 days to complete before the furnaces were ready for another campaign.

With regard to the steel-sheet trade, until comparatively recent years this was confined to South Wales and the Midland Counties, but by the enterprise of pioneers of industry in the Middlesbrough district, the galvanised steel-sheet trade was very rapidly expanding, and from a geographical and economic point of view, the President saw no reason why the manufacture of tin plates should not be successfully introduced locally.

Iron Foundry Practice.

THE PRESIDENT stated that it was an industry closely allied with the steel trade, and having been connected with it for many years he had seen many changes which had taken place in the demand for iron castings and the methods of manufacture.

It was customary not very many years ago for a practical man to select his pig-irons by the appearance of the fracture, and in this a certain amount of skill was required. The pig-iron, after being melted in a cupola, was poured into the mould in the usual way, and the quality of the castings depended entirely upon the quality of iron charged, and the coke used for melting. This process is still in use for castings which are required in large quantities, and not of a definite composition. Castings are now required which will satisfactorily resist tensile, transverse, and torsional strains at varying temperatures, the pig-irons therefore are usually selected by chemical and practical tests and melted in air furnaces by hand-picked coal, reasonably free from sulphur. This process of melting, although extremely expensive, enables the metallurgist in charge to take samples of the melted metal and make whatever additions are necessary to comply with a very definite specification.

Chill and Grain Roll Making.

This method is employed by ironfounders in the manufacture of chilled and grain rolls. The industry was introduced into this district about 15 years ago, and in consequence of the rapid development in the steel trade, the necessity of employing larger and better rolls has compelled the makers to study the question more closely, and although at the present time chilled rolls are made up to 30 tons each and grain rolls 40 tons each, the changes in the conditions of working the rolls necessitate very special study on the part of makers to satisfy the demands.

The President had been associated with the making of chilled rolls and rolling mill machinery the greatest part of his life, and was quite satisfied that, like in all other industries, there were many things yet to learn.

A chilled roll, he said, was distinguished from a grain roll by the surface being chilled or hardened. The depth of chill was influenced by the composition of the irons used, temperature of the metal when casting, and temperature and thickness of the iron mould in which the roll is made.

The roll was cast in a vertical position. The molten metal was run into the bottom end of mould at an angle, which induced the metal to spin, and any sand which was collected by the flow of metal from the runner remains in the centre, and was conducted through the top of the mould.

The life of a chilled roll varied very considerably, depending to a great extent upon the skill of the user, the heat, quality, and thickness of the steel being rolled, but in exceptional cases a pair of chilled rolls had rolled over 80,000 tons of steel plates before being scrapped.

The life of sheet rolls was, of course, shorter, as it was not possible to roll the sheets with water running upon the rolls, as was the case with plate rolling.

The manufacture of grain rolls had been improved very much in recent years by the use of alloys, and it was not uncommon for rolls made by this special method to produce 2,000 tons of rails in one finishing groove without dressing, whereas only a few years ago 250 tons was considered to be good work.

The designing and turning of grain rolls was an extremely important detail in the production of steel sections, which are now subjected to very careful inspection, and the marginal limits of measurements and weights are extremely small. It is not possible to introduce standard designs for roll turning, and the centres and lengths of rolls vary so widely in the different works, and the power and speed of the engines and motors driving the mills have an important bearing upon the design of the rolls.

Trade Talk.

SIEMENS & ENGLISH ELECTRIC LAMP COMPANY, LIMITED, have established a branch at 2, Wood Street, Cardiff.

CHARLES DAVIS & COMPANY, of 25, Rood Lane, London, E.C., have removed to 7, Whittington Avenue, London, E.C.3.

THE £40,000 DEBENTURES of Henry Bessemer & Company, Limited, which fall in for redemption on December 31 next, will be repaid on that date.

A FIRE broke out at the premises of the Alloy Castings, Limited, Ellin Street, Sheffield, last week, but the damage was not exceedingly heavy.

CROSSLEY BROS., LIMITED, of Manchester, have acquired the business of the Saunderson Tractor & Implement Company, Limited, Elstow, Bedfordshire.

MARKHAM & COMPANY, LIMITED, of Chesterfield, have booked a contract for a number of tunnel shields required in connection with the London tube extensions.

AT THE CLUB of the Sheffield Association of Metallurgists, last week, Dr. Rogers read a paper entitled "High Power and Rapid Photomicrography of Metals."

AT A MEETING of the Stoke-on-Trent Association of Engineers, Mr. A. T. Green, who is a member of the Association, read an interesting paper on "The Corrosion of Metals and Alloys."

MR. R. MILLETT, Star Buildings, 30, Cross Street, Manchester, has been appointed agent in the Lancashire area for the Jackson Electric Stove Company, Limited, of Sloane Street, London, S.W.1.

THE WORKS AT Brimsdown, Middlesex, of the London Foundry Company, Limited, are being offered for sale by tender. The offer comprises about 23½ acres of land, and the foundry buildings, with an area of 53,800 sq. ft. The equipment includes two 10-ton cranes, three electric furnaces, etc., for an output of 200 tons of steel castings per week.

BY MUTUAL AGREEMENT, following a conference between the employers and five trade unions concerned, the engineers of the Stanton Ironworks Company, Limited, have accepted a wage reduction of 3s. 6d. per week, from December 31, to be followed by a further cut of 3s. on March 3, 1924. The wages of labourers are to be reduced by two instalments of 1s. 6d. each on the same dates.

THE second annual meeting of the Engineers' Club was held last week. The president, Sir Robert A Hadfield, Bart., in moving the adoption of the report, congratulated the members on the results, which he thought were surprisingly good, seeing the adverse trading conditions which had effected the engineering industry during the last 12 months. Mr. Howard Foulds, chairman of the General Committee, seconded the resolution, which was carried. Sir Robert Hadfield proposed that Sir Joseph W. Isherwood, Bart., be elected president of the Club. He mentioned his eminence in the shipbuilding world, and the fact that an enormous tonnage had been built in recent years on the Isherwood system of shipbuilding. Mr. J. B. Whyte seconded, and the resolution was carried. In order to fill the vacancy on the board, caused by the death of Mr. H. T. Wilkinson, Mr. Howard Foulds was elected a director, and was also appointed honorary treasurer. Mr. E. L. Hill was re-appointed honorary secretary.

Obituary.

MR. G. H. LAWLER, of Furmston & Lawley, engineers' pattern makers, Bird's Hill, Letchworth, Herts, died recently.

MR. A. COX, chairman of Cox Bros. & Company (Derby), Limited, of the Lead Works, Derby, died recently, aged 77.

MR. W. H. HOWARD, a director of George Howard, Limited, scrap metal merchants, of Folly Lane Bridge, Warrington, died on October 29, aged 51.

MR. J. K. LORD, formerly connected with R. Lord & Son, of Barnbrook Boiler Works, Brook Street, Bury, died on November 1, in his 72nd year.

MR. W. H. S. CRAVEN, chairman and managing director of Craven Bros. (Manchester), Limited, died suddenly on October 30. Mr. Craven was formerly a director of the Staveley Coal & Iron Company, Limited, and was a member of both the Institutions of Civil Engineers and Mechanical Engneers.

MR. R. GIBSON, of Ivy House, Tettenhall, who died last week at the age of 84, was the managing director of Baker & Crockett, Limited, hardware merchants, of Snow Hill, Wolverhampton, and was a vice-president of the National Hardware Association and of the Royal Metal Trades Pensions Society for South Staffordshire.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Business in the Cleveland iron market during the current week has taken a quieter turn as compared with recent activity, values meantime having retained the firmness recently noted. This change in conditions can unquestionably be explained by political reasons, the announcement of an immediate dissolution having had an unsettling effect upon trade in general, more particularly, perhaps, in relation to the buying movement in the pig-iron market, which has experienced a temporary check. The prospect of an acceptance by ballot of the terms in the boilermakers' dispute must, however, eventually counteract the consequences of the political disturbance, and there are already signs of a revival of activity in the shipbuilding yards in anticipation of a renewal of work in that important industry. Meanwhile, Tees-side makers are now very well sold, and are holding prices firmly. During the next week or so there will be an increase in the output. This will indirectly enlarge the quantity available for the market, though, no doubt, a considerable proportion will be required for direct consumption in the steelworks. Prices are unchanged as follow:—No. 1, 107s. 6d.; No. 3 G.M.B., 100s.; No. 4 foundry, 99s.; No. 4 forge, 98s. per ton.

The market for hematite continues steady, with prices showing increasing firmness. Home demand is now absorbing a substantial proportion of the output, and although the export trade remains inelastic, the general outlook for the winter months is regarded with growing confidence. At the moment, East Coast mixed numbers are not obtainable under 101s. per ton, though some makers are asking up to 101s. 6d. No. 1 is at a premium of 6d. to 1s. per ton. A very considerable tonnage has been booked in the last month. In Cumberland and North Lancashire prices have actually stiffened on previous quotations when Bessemer mixed numbers ruled at 112s. 6d. per ton delivered at Glasgow and Sheffield, while now it is questionable whether ordinary iron could be bought at less than 115s. per ton delivered at Sheffield. This is a figure at which makers for the first time this year will have a bare margin of profit.

MANCHESTER.—Improvement in market conditions, so far as concerns Lancashire, is slower than might be anticipated, foundry demands being still on a disappointing scale, while many consumers who bought on forward contracts, many for three and even six months in advance at lower figures than those now ruling, have not yet exhausted deliveries. Consequently, current demands are restricted, the business done recently having no doubt been in anticipation of the orders for castings, which will result from railway and Government expenditure during the next few months. One group of the railways alone has proposed to spend about four millions on engines and wagons, and although not much, if any, of this work will come to Manchester it will indirectly tend to improve the ironfoundry trade in this district. Sellers of No. 3 Derbyshire pig-iron usually quote 101s. per ton for delivery local. Lincolnshire No. 3 is quoted at 93s. at the furnaces, and would cost a little more in Manchester than Derbyshire. For Scotch iron merchants usually quote 120s. per ton delivered.

THE MIDLANDS.—So far, the recent improvement in demand for pig-iron has been steadily maintained, though without any great disturbance in current prices. Complaints are still heard that the foundry trade is far from active, but with all its remaining deficiencies the market is a great deal better and more healthy than it was a month ago, and there is hope that we are within measurable distance of reasonably profitable trade. Quotations:—Northamptonshire No. 3 foundry, 92s. 6d.; Derbyshire No. 3 foundry, 92s. 6d. to 95s., all net f.o.t. furnaces.

SCOTLAND.—Conditions in the Scottish iron trade continue firm, with a fairly good volume of business passing, while the tone of markets is distinctly more cheerful than has been the case of late. What little Lincolnshire pig is on offer at Glasgow is taken up, and if the demand for Derbyshire material continues to expand it will be necessary to put further furnaces in blast. Scotch makers are now quoting 103s., but are not keen sellers for forward delivery, being convinced that, in comparison with costs, prices are still too low. In the export market there is very little doing, and No. 3 foundry is quoted at 107s. 6d. f.a.s. Glasgow.

Steel.

At Sheffield reports are current that a reduction in the prices of acid billets is anticipated shortly, but for the present makers hold firmly to the quotations now ruling. Soft basic billets, indeed, show an upward tendency, and it is not easy to place business at less than £8 5s. delivered. It is reported that some Belgian billets are being offered, delivered Sheffield, at £7 2s. 6d., but the quantity appears to be limited. In the market for alloys the home demand for ferro-manganese shows signs of slight expansion, consumers having been attracted by the reduced level of values. The export demand, however, has not recovered to any material extent. The tone of the tinplate market is very firm, and now that the manufacturers have decided to continue their price stabilisation scheme to the end of 1924 at least, lower prices than those ruling to-day cannot be looked for in the near future. Current quotations may be called firm, as follow:—Coke tins, IC 14 by 20, 112 sheets, 108 lbs., 23s. 3d. to 23s. 9d. per box; IC 28 by 20, 56 sheets, 108 lbs., 23s. 9d. to 24s. 3d. per box; lights at ¾d. per lb. reduction, net cash, f.o.b. Bristol Channel ports.

Scrap.

Considered from an all-round point of view, the position of the scrap metal markets in most centres of consumption may be described as distinctly improving, while as compared with new raw material prices are maintained at reasonably moderate levels. In the Midlands merchants generally have no large stocks for disposal, and big parcels are not being negotiated. The scarcity is somewhat difficult to account for, other than that the demand greatly exceeds the supply, with the inevitable result that prices have considerably stiffened. The Lancashire market for cast scrap iron remains rather quiet at from 85s. to 90s. per ton, and may not improve until the foundries of the country are busier. It is reported that a number of the Scottish foundries are better off for orders, and the improved demand for cast-iron scrap still continues. It is stated that 100s. per ton has been paid for heavy machinery cast-iron scrap and scrap railway chairs, but, generally speaking, the average price can be taken at around 97s. 6d., with ordinary heavy cast at 92s. 6d., and light cast-iron and furnace fire-bars about 73s. 6d. per ton.

Metals.

Copper.—Market movements in standard metal of late have disclosed a further upward tendency, while the business done suggests much stronger confidence in the outlook from the consumer's point of view, both at home and countries abroad. Producers in America report good buying by domestic consumers for early delivery, and in the expectation that this purchasing will extend forward 13 cents is now asked for early next year delivery. Consumers here have bought fair quantities, and the market, aided by the depreciation in the sterling exchange, has been uninterruptedly firm. Current quotations:—*Cash*: Thursday, £62 5s.; Friday, £61 5s.; Monday, £61 7s. 6d.; Tuesday, £61; Wednesday, £61. *Three Months*: Thursday, £62 17s. 6d.; Friday, £61 15s.; Monday, £62; Tuesday, £61 12s. 6d.; Wednesday, £61 12s. 6d.

Tin.—The past week's business in standard tin, though at times slightly irregular, has indicated increasing strength based upon an improvement in the statistical position and a convinced impression that even higher values are likely to materialise in the near future. The main source of strength in the market has, however, been important buying by American interests, which, coupled with a fairly substantial home consumption, makes the position unusually secure. Home stocks at the end of October were 3,088 tons, against 3,138 tons at the end of September. That a further rise in tin prices is possible is supported by a comparison with 1913 values, when costs were much below those now ruling, and up to £232 per ton was paid for tin. As regards American support, the growth of their consumption is illustrated by the United States delivery figures recently published, showing the total for twelve months, ended October 31 last, as 68,000 tons, against 55,000 tons for the corresponding period of 1921-22, and only 25,000 tons in 1920-21. Current quotations:—*Cash*: Thursday, £217; Friday, £218 5s.; Monday, £220; Tuesday, £221 5s.; Wednesday, £223 7s. 6d. *Three Months*: Thursday, £217 2s. 6d.; Friday, £218 12s. 6d.; Monday, £220 10s.; Tuesday, £221 15s.; Wednesday, £224.

Spelter.—The outstanding feature in last week's market for this metal has been the maturing of options, which has supplied the market with a quantity of prompt metal immediately available for liquidation. The spot quotation has fallen accordingly, but the establishment of a contango, as indicated, is merely due to the temporary and technical condition of the market, and is no sign of a change in the

fundamental situation of spelter. Current quotations :—*Ordinary* : Thursday, £32 15s.; Friday, £32 7s. 6d.; Monday, £32 7s. 6d.; Tuesday, £32 5s.; Wednesday, £32 7s. 6d.

Lead.—Although somewhat irregular in tendency the market for soft foreign pig may be regarded as fairly strong, with supplies of prompt metal becoming again restricted. More caution is apparent in this market than recently, but the position of supply and demand is evidently sound, and until a change occurs, there is no reason to anticipate any weakness. Current quotations :—*Soft foreign (prompt)* : Thursday, £30 12s. 6d.; Friday, £30 5s.; Monday, £30 5s.; Tuesday, £30 5s.; Wednesday, £30 5s.

London Foundrymen Visit Motor Car Factory.

Last Saturday about thirty members of London Branch of the Institute of British Foundrymen visited the works of Messrs. A. Harper Bean, Limited, of Dudley and Tipton. Before lunch, which was served at the Dudley Works, the visitors were shown over the body building department, and an opportunity was taken to inspect the grinding machines in which the firm specialise.

At the luncheon, Mr. V. C. Faulkner, the London Branch President, thanked the firm for the kind reception which had been accorded to them. The foundries which Messrs. Bean had erected ranked amongst the best equipped in the country. In proposing the health of their hosts, Mr. Faulkner said the visitors greatly appreciated the kindness of Mr. Bean, managing director, Mr. H. A. Greaves, financial director, Mr. A. Marks, works metallurgist, Mr. A. Richards, foundry superintendent, and Mr. Morris, foundry manager, in sacrificing Saturday afternoon for their benefit.

Mr. H. A. Greaves, who responded, said this was the first visit they had had from any organised body of foundrymen, and he hoped that they would be interested in the Tipton foundries. These foundries, although primarily intended for the production of iron castings for the Bean car, also made large quantities of pipe, ingot mould and railway castings. He very much appreciated Mr. Faulkner's remarks.

During the afternoon, the foundries, which have been fully described in THE FOUNDRY TRADE JOURNAL, were inspected. Since that description appeared, however, several modifications in practice were noted. The core sand, for instance, is now dried before mixing with the oil. Finally, the machine shops, which are excellently equipped and laid out, were inspected.

The arrangements were excellently carried out by Mr. H. G. Sommerfield, the recently appointed secretary.

Catalogues Received.

Steam and Electric Cranes.—The Bedford Engineering Company, of Bedford, have sent us their new catalogue, which deals with locomotive and fixed steam and electric jib cranes, grab buckets, electric overhead travelling. Foundrymen will find this a useful addition to their catalogue reference files.

Conduits.—From the General Electric Company, Limited, of Magnet House, Kingsway, W.C.2, we have received an interesting brochure bearing the title "Geekoduct" conduits and accessories. It has particular interest for foundrymen, as the modern foundry has a multiplicity of electric connections for extra local lighting and for electric tools. We understand that this catalogue is being circularised to the trade, and foundrymen would do well to secure a copy.

Publications Received.

Research Work.—We have received from the Keighley Laboratories, Limited, of South Street, Keighley, a series of post card photographs which illustrate typical foundry problems. They include micro-photographs of the graphite in cast iron, the breaking down of accicular structure in a steel casting, the annealing of malleable and the phenomenon of internal chill in cast iron.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Bribery in the Foundry,

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I am a little surprised to find you introducing such a subject into what is considered a journal devoted to technical subjects, rather than one for the washing of dirty linen. Speaking from the moulder's standpoint—and I consider he is the only man that matters in the foundry—your leader on the above subject can only help to push him further into the mire. It was thought when foundrymen formed the Institute that they had taken a step to improve their status in the engineering world, and I fail to see how your article is going to assist technical advancement. The subject is a wide one, and does not apply to the moulders in general, nor even does it apply to foremen moulders in particular. You give a case of a furnaceman, but I do not think many furnacemen are in a position to order material in any well-regulated foundry. The same thing applies in the case of most foremen moulders, as it is seldom they are in the position to order direct. Any of the higher positions are more or less given to men of the hybrid class, as employers in many cases would never dream of appointing a moulder to manage his foundry. Seeing you have set the ball rolling on this subject, it is worth while finding out to whom the disgrace belongs—this hybrid class or the moulder. I hope some of them will have something to say on their own behalf.—Yours, etc.,

TOM BELL.

2, Bellfield Street, Barrhead.

[We are afraid our correspondent has not read sufficiently carefully the article in question. We agree that our aims are definitely associated with the technical advancement, and the payment of secret commissions operates against technical advancement, because purchases are made on a basis other than quality. The universal refusal of bribes by foundrymen cannot but help to raise the status of the industry. It seems evident that our correspondent is unfamiliar with the numerous small non-ferrous foundries where the foreman combines his normal duties with those of buyer and melter. Finally, some travellers get beyond the buyer and bribe a workman to recommend their goods; thus competitive material may be rendered defective or inferior. We trust that we have now made it clear how technical advancement can be prevented.—ED.]

Gazette.

TRADING IN THE STYLE of T. Burton & Son, Messrs. T. Burton and N. Burton, 9, Boothroyden Road, Rhodes, Lancs., scrap metal, etc., dealers, have dissolved partnership. Debts by both partners, who agree to be jointly and severally responsible for same.

IN THE MATTER of the Boarshaw Engineering Company, Back Brook Street, Boarshaw Road, Middleton, engineers, millwrights, smith, etc. Pursuant to Order of C.C. Oldham, made in an action, Smith against Smith & Walsh, the partnership subsisting between A. Smith and H. Smith and J. Walsh, trading as above, was dissolved, so far as A. Smith was concerned, as and from October 18.

Patent Specifications Accepted.

Particulars of complete specifications accepted, furnished by Mr. Eric Potter, Patent Agent, of 27, Chancery Lane, London, W.C.2. Printed copies of the specifications in the following list are now on sale :—

Iron, Steel and Metallurgy.

206,183. MARKS, E. C. R. (American Manganese Steel Co.). Heat treatment of manganese steel. May 29, 1922.

190,722. ARCHER, R. S., and JEFFRIES, Z. Aluminium base alloys. December 20, 1921.

Mechanical Transmission and Appliances.

191,022. ALLMANNA SVENSKA ELEKTRISKA AKTIEBOLAGET. Reversible Power-transmission devices. January 2, 1922.